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Rural Engineering

A REORGANIZATION of the U. S. Department of Agriculture, in which all departmental functions of an engineering character will be brought under one bureau, is proposed in an appropriation measure now before Congress. Under it the Office of Public Roads would become the Office of Public Roads and Rural Engineering. Drainage investigations and farm irrigation, now handled separately, would go to the enlarged office, while new divisions of farm structures and farm machinery would be included. The appropriation requested is $700,000. The logic of this rearrangement is evident. Drainage and irrigation investigations are now, for no apparent reason, under the Office of Experiment Stations. Consolidation will reduce administrative expenses, will more easily allow of transfer of men from division to division, as the exigencies of work may require, and, by adding together the experience of formerly isolated workers, make for higher general efficiency. Congress should approve the recommendation made by Secretary Houston.

Arizona Alien Law Void

FOLLOWING close upon the decision of a New York State court that the law prohibiting the employment of alien labor on public works in unconstitutional a Federal court, sitting in San Francisco, has handed down a similar finding on the Arizona act restricting the number of aliens on public works to 20 per cent of the total. It would be surprising if, with the clear-cut opinions already rendered, the New York court of appeals should not take the same view. The court held in the Arizona case that the law deprived aliens of the right to labor guaranteed them by the Fourteenth Amendment to the Constitution. "If under the guise of police regulation," the court says, "a State can prohibit an employer from employing more than 20 per cent of alien labor, it can prohibit him from employing more than 5 per cent, and if 5 per cent, from employing any at all. The Supreme Court of the United States recently has held that the right to labor is a right of property. An alien cannot be deprived of the right to property under the Constitution of the United States." In this direction, at least, the attempt to mulct the public has been foiled.

The Subway Interruption

LAST week's interruption in the New York subway, the longest in its history, suggests changes in electric wiring features and possibly in construction and prompts comment on the comparative freedom of that system from accident. It has now been in operation for ten years, but never before has it been obliged to suspend traffic for more than a few hours. Fatal accidents have been rare,—none during the year ended June 30, 1914. In last week's tie-up the danger was largely due to panic, though many were overcome by smoke, owing to the delay in allowing the passengers to leave the cars. There have been many suggestions as to desirable changes since the accident; such as are meritorious are having the consideration of the authorities and will be made the subject of a report. Two measures, however, seem so logical that one can predict favorable recommendation; that the splicing chambers should be isolated from the subway and that the lighting in the tubes be kept entirely separate from the power feeders, so that no interruption to the operating current, from short circuit or otherwise, could leave the tunnels in total darkness.

Privately Financed Sewers

WHILE privately owned waterworks plants, roads, bridges, and refuse disposal works are common enough, a sewerage system financed and built privately for the benefit of a municipality is a decided novelty. In the United States there have been only a few cases similar to that at Troy, Pa., described by Henry W. Taylor on page 79. The limit of the town's bonded indebtedness prevented the installation of the system as a municipal enterprise. The citizens, therefore, as a private association, undertook the work. There is nothing out of the ordinary in the engineering features of the project; interest centers in its legal and financial aspects. There are four parties involved—the subscribers, who furnished the funds; the trustee; the borough of Troy; and the property owners, who pay to the borough an annual rental for connections to the system. The subscribers vest all rights to funds and to the plant in the trustee, and the borough contracts to rent the entire system from him and pay him 5 per cent yearly on the investment. The borough, out of the rentals, maintains and repairs the system and pays the interest. It also has the right to purchase the system at cost. The same plan might well be used by other communities which need improvements but are unable on account of legal limitations to secure the necessary funds.

Pearl Harbor Drydock

A VEIL of mystery, through which has filtered little information to the engineering public, has surrounded the Pearl Harbor drydock for almost two years. It was known in a general way that the construction method which had been tried was a failure, and that to make it a success would cost much in excess of the funds available. It was also known that the late Alfred Noble had examined the site and made recommendations. It was generally thought that the whole project was dragging along and would emerge, after a period of consideration in Congress, with an increased appropriation, at some indefinite time in the future. It appears, however, that all this time the Government's engineers have been at work, devising methods to turn the original failure into a success. They have now come forward with a practical and economical plan which will be put into immediate execution. This plan, detailed elsewhere in this issue, calls for the sinking of successive sections of the dock floor, each surmounted in turn by the same removable steel cofferdam, within which the side walls of each section can be finished while the bottom of the next section is being prepared for launching. The main idea and details of this scheme, which seems perfectly feasible and much less expensive than making the whole dock a single large caisson, have been in large part the work of the engineers of the Bureau of Yards and Docks, who deserve much credit for their work.

Bartering Professional Services

ABOUT a year ago the Institution of Civil Engineers of Great Britain, in a communication to its members, deprecated the practice on the part of municipal authorities of inviting engineers to submit, in competition, terms for preparing plans and proposals for engineering work. The communication said in part: "In the opinion of the council such a proceeding is very undesirable in the best interests of the public authorities themselves and of the engineering profession. The council desire to express emphatically the repugnance with which they regard the practice in question. They have every confidence that the members of the institution will support them by declining to respond in any way to such advertisements as those alluded to." Apparently, this support has not been as hearty as could have been desired, for a number of members have transgressed in the case of a sewerage project at Monmouthshire and by their action have evoked from the council another general communication, dated Dec. 7. The communication characterizes this bartering of professional services as "an action of professional misconduct which renders the offender liable to expulsion from the institution." While the more prominent members of the profession in the United States are not open to such criticism, it cannot be said that others are blameless. Any one familiar with the ordinary procedure of securing expert advice, particularly on municipal projects, knows that bargain-counter methods are entirely too prevalent. It rests with the engineers themselves and with the engineering societies to correct the abuse and to educate municipal authorities to proper standards in the employment of professional men. Progress will be slow, but the eventual victory will be worth all the pains.

Danger from Typhoid Carriers

NOTICE to boil the water in a certain section in Chicago appeared recently in the daily newspapers and in the official bulletin of the Department of Health. The water under suspicion came from the Two-Mile crib, the one nearest the mouth of the Chicago River, and is at most times less satisfactory in quality than that from other intakes. Regular samples did not indicate any special pollution, and there was a typhoid increase only in the district supplied by the Chicago Avenue pumping station, one of the two taking water from this crib. This circumstance led to an examination of ten workmen employed in making alterations in the pump wells at the station. Three of them gave positive Widal tests and one has been proved to be a typhoid carrier. On some of the cribs supplying water to Chicago hypochlorite of lime plants have been in operation for some time, but none was installed on the Two-Mile crib.

Though it was impossible to determine the actual cause of the pollution, the necessity for care in assigning men to make well repairs is suggested by the incident. The use of a bacterial test to determine whether the prospective employee is a typhoid carrier or not is certainly a new angle to the employment problem. The dictates of common decency, it need hardly be said, should be observed by men engaged in such work. It is interesting to note that in all probability in this case a hypochlorite plant would not have safeguarded the supply.

The Passing of Naval Coal

THE transition from coal to oil as the standard fuel marks perhaps the most radical development in naval engineering since the advent of the steam turbine. In the United States Navy experiments with liquid fuel date back nearly fifty years. These have all confirmed the belief of engineers in the military advantages of fuel oil, but until recently uncertainties as to supply have restricted its use. Naval authorities are now assured that on the public lands of California alone there is sufficient oil to supply all probable naval demands for a century, should oil be burned to the exclusion of coal, and there is, of course, considerable oil elsewhere in the country. The transportation of this fuel, whether by sea or by land, is a much simpler problem than the handling of coal.

In his annual report, the Secretary of the Navy states that henceforth all fighting ships added to the fleet will use oil and that the transition from coal will establish an era in naval development almost comparable with the change from black to smokeless powder. The advantages of oil illustrate the engineering basis of modern military operations on the sea and are of much technical interest. Compared with coal, oil produces an evaporation of water per pound of fuel in about the ratio of 14 to 9, and per square foot of heating surface in about the ratio of 10 to 8. Fuel can be taken aboard more rapidly, without manual labor, and without interruption to ship routine. These points directly influence military efficiency, and the discomforts of coaling ship need no longer be endured, with their demands upon the crew and inconvenience to every branch of the service afloat.

Steam for full power can be maintained as readily as for low power, with no reduction in speed at critical moments due to dirty fires, to difficulty in trimming coal from remote bunkers, or to exhaustion of the fireroom force. There are no cinders, and the amount of smoke can be controlled. A considerable reduction in personnel is possible with fuel oil, which reduces the weight of and space required for boilers and shortens the firerooms. The elimination of coal and ash-handling gear renders unnecessary the piercing of the hull for coal trunks and discharges from the ash ejectors.

In the battleships "Nevada" and "Oklahoma" the exclusive use of fuel oil has, by reducing the boiler weights, made possible the use of heavier armor than heretofore. The reduction in length of boiler compartments has permitted the grouping of all boilers under one smoke pipe, clearing the upper decks considerably and permitting more extensive arcs of gun fire from the turrets. These advantages are significant, and with the prospective development of internal combustion marine engines for heavy service now in sight and the success reported from the trials of electric drive aboard the collier "Jupiter," leading to the authorization of the motor drive for the battleship "California," interest will not be lacking in the engineering side of marine propulsion for some years to come.

The Converging Curves of Steam and Water-Power Costs

DURING the past few years the cost of electric power has received well deserved attention in engineering circles, and it is a question if any other problem more closely approximates what might be called a common denominator of inter-professional interest. The progress of the steam turbine has brought about changes of great significance in the relation of steam to hydroelectric costs. Only a little while ago it was generally conceded that electricity developed by waterfalls must inevitably be cheaper than energy produced in a steam plant, and even to-day the general public inclines toward this opinion.

At the recent hearings of the Senate committee on public lands upon one of the water-power bills, John A. Britton, vice-president of the Pacific Gas & Electric Company, and Hugh L. Cooper, consulting engineer, New York, brought out the point that the capital costs of modern high-powered steam plants and of many hydroelectric developments are coming close together. Forty years' experience, including exceptional opportunities for observing present-day tendencies, led Mr. Britton to predict that the time is not far distant when in many instances, steam-electric power will be produced at less expense, all things considered, than hydroelectric energy. This situation was foreseen by Austin C. Dunham, of Hartford, at least three years ago. A résumé of the testimony will be found on page 75.

Many figures were presented at the committee hearings bearing upon costs of production and transmission on the Pacific system. The average cost of energy delivered at the 200 substations of the company is about 7.3 mills per kilowatt-hour. Steam power has been generated and delivered practically under the same conditions for less money where the great labor-saving capabilities and fuel economies of high-powered steam turbine plants have been realized on a first-class load-factor. It is perhaps not generally appreciated by engineers that a modern steam turbine station of large size, using units of say 10,000 to 20,000-kw rating and upwards, can be built to-day for from about $60 to $50 per kilowatt of maximum capacity. Few hydroelectric plants can meet this range of unit first costs, although the Nevada City plant of the Pacific company was developed recently at a cost of about $68.50 per kilowatt, due to unusually favorable hydraulic conditions. The more common hydroelectric unit costs of from $200 to $250 per kilowatt must be considered in any broad comparison.

The belief among certain classes of the public that water powers yield disproportionate profits springs from the conception that the cost of development and the expenses of operation are small, while the income is large. It is difficult for the public to realize that the dam, headworks and power plant once built involve heavy continuing expenses, which are in reality comparable with the cost of coal or oil in a steam station. The expense takes the form of interest, sinking fund charges, depreciation and taxes. The invested capital in a water power is so much greater than the public realizes that with interest charges of not more than 5 or 6 per cent in a majority of cases from 70 to 80 per cent of a water-power company's income is absorbed. Of a water power once built, and after the expected market has been developed, the operating expenses, exclusive of the returns to capital, which should include a profit in addition to interest, are seen by the public to be small. In many cases they absorb only 15 or 20 per cent of the income. The balance left after capital charges are met is seldom large and very rarely indeed excessive, in view of the ever-present risk of damage by floods, lightning, failure of the expected market to develop, and such uncertainties of operation as the art of electrical engineering has not yet been able completely to remove.

Water powers are developed only after answering satisfactorily the question as to the cost of steam power in the territory. They can only live when they deliver power at a rate substantially lower than that of a steam station. At the same cost they remain undeveloped. Few steam plants with skilled designing cost over $100 per kilowatt to build under present conditions. The first cost of a hydroelectric plant depends largely upon topographical and hydraulic conditions. It is because of the great effect of slight differences in the cost of water power upon the decision to develop in a given community that even light burdens in fixed charges or limited tenure, even though not immediately onerous, loom so large in settling the matter. With modern steam turbines an operating cost of 3 or 4 mills per kilowatt-hour should be attained without serious difficulty where high load-factors are available, and 2.5 mills is certainly in sight for a station equipped with units of 20,000 or 30,000-kw rating. Possibilities like these throw the question of ultimate cost of steam and water power into the field of fixed charges.

Water powers are by no means going out of fashion, but it is high time to realize that there has been quite as much progress in steam engineering as in high-voltage transmission and that off-hand judgments, taking for granted the invariable superiority of hydroelectric developments over fuel-burning plants, are extremely hazardous.

The Needs of the American Society of Civil Engineers

THE approaching meeting of the American Society of Civil Engineers makes appropriate a discussion of the needs of the society. Such discussion has not been infrequent. In fact, agitation has been persistent for some years. Colonel Ockerson advised in his presidential address that the society endeavor to exercise its influence in public affairs, that the number of local associations be increased and that, each year, there be a number of conventions or general meetings, rotated by districts. Professor Swain, at Ottawa, repeated Colonel Ockerson's first suggestion and recommended additional technical committees and the appointment of a committee on public relations in which each State would have representation. "Our society," said Professor Swain, "is large, rich, influential, but we have been too content to sit down in dignified ease, taking little or no initiative and allowing other and younger societies to outstrip us in actual work performed and in real influence exercised. . . . We have no reason to be afraid of having too many committees. We should rather be sure that we lose no opportunity to exercise legitimate influence on public opinion or to aid in the solution of large problems."

As a result of these suggestions the formation of local associations has gone on apace, the number growing in two years from three to fourteen. In the same period five new special committees have been appointed. Despite the success of the New Orleans gathering, however, no other interim conventions have been held, and little effort has been made to take an active part in public affairs.

In the judgment of this journal, however, the real ailment has not yet been pointed out, though it is implied in the recommendation that the number of local associations and of conventions be increased. The trouble is, in the last analysis, that the members lack interest in the society. It stands now in an impersonal relation to them—a thing apart, that does not attract, that is grandly cold and forbidding.

Three remedies, we believe, must be applied: first, publicity for the work of committees; second, the adoption of a more democratic spirit in meetings; third, an extension of the "federal" form of organization.

The first of the remedies, publicity for committee work, was discussed at length in this journal last week. Committee work is now conducted on the star-chamber plan. Members do not know what the committees are doing and consequently are unable to contribute their experiences. The committee work, accordingly, suffers, while the society loses the loyalty and enthusiasm which comes from knowing what the organization is doing and from participation in its activities. The programs of committees should be published and, at intervals, news of important steps in their work.

The second remedy involves a radical change in the atmosphere of the organization, the destruction of the forbidding formality which now prevails and the substitution of a more democratic spirit. The frigidity of the New York meetings is unbelievable without experience, and the change would affect them chiefly. At first glance this seems to be a local problem. It is not, however, for New York, being the society's headquarters, is in a position to fix the standards for the whole organization. The Denver and San Francisco associations are sociable not because of, but despite, the spirit at New York. There should be a reception committee there to see that no one, be he a local or an out-of-town member, is allowed to spend the evening holding up a pillar because of his lack of acquaintance.

The very principle of the New York semimonthly meetings, moreover, is wrong. They are, supposedly, national gatherings, but they are not national in any sense of the word. The problems of the society as a whole are never discussed; the attendance has not a national character. On the plea, however, that the meetings are national, most of the papers are read, even though they relate to matter not of local interest, or are too technical for discussion except among little groups of experts. The result is inevitable—a meager, discouraging attendance and little or no discussion.

This should be changed at once and the New York meetings made in name what they are in fact—meetings of the New York members. The subjects should then be chiefly of local interest. There should be a program committee in charge of the New York meetings—in fact, a New York association of members, with all the privileges accorded to other branches.

Finally there is need for a radical change in organization, by the development of a "federal" form, which would broaden the present local-association plan and carry further the movement started by the proposal to give each district sole control over the nomination and election of its representative on the board of direction. The local association, as now constituted, does not effectively go beyond the city in which it is established. It does not provide for the members resident in the district but in communities too small for local branches. The privilege of selecting their own representative on the board of direction will have a tendency to give members of the district a feeling of mutual interest. But they need more. They should be personally acquainted, for then only will they be able to co-operate in local matters of moment to engineers. There should be district associations, each with its officers and its meetings at stated intervals. Local problems would form the best subjects for discussion, but inevitably the business affairs and activities of the national organization would receive much fuller discussion than is now possible. Local interest would be the parent of national loyalty, while the more effective method of organization would insure a readier response to appeals from the board of direction than can now be secured through formal communications from a distant headquarters to 7500 isolated units.

Before such a method of organization could be adopted, many details would have to be worked out, but that the tendency of the society is in this direction no careful observer can doubt. So important does the board of direction regard the conference of presidents of local associations next week that it will pay the traveling expenses of these officials to the New York meeting. That in itself is evidence of the feeling of the board of direction on at least one phase of this subject.

Precedent for this form of organization, if any be needed, can be found in the Verein Deutscher Ingenieure, with a membership of 25,000. Membership in it can be held only through local branches, which are largely autonomous and participate to a surprising extent in the discussion of local public questions. In the German society, too, a portion of the dues of each member is returned by the national organization to the local branch—a form of support that must inevitably follow if the local branches fulfil their mission and really do valuable work for the society.

Present tendencies in every field are toward democratization. The cry against autocrats was louder than the first rumble of the European war. The wise corporation official has changed his motto to read "the public be pleased." Industry's tyranny over the individual has been broken by workmen's compensation acts. Co-operation, fellowship, representative rule are succeeding the cruder forms that preceded.

The movement in the American Society of Civil Engineers is of the same order. In a small way it mirrors the large swing of world events and race tendencies. Its ultimate results none can doubt. It behooves those who have placed the society on its present eminence, and have made it financially impregnable, to take hold in the new spirit, that the society may broaden and grow, grasping the larger opportunities which a more complex age is placing before it.

LOADING A DUMP WAGON WITH THE STEAM SHOVEL

LEVELING UP WITH SCRAPER ATTACHED TO DIPPER

Methods of Excavation for Buildings

Cost and Performance Records on a Large Factory Where a Steam Shovel Was Used, and On Another Where Drag Scrapers and Hand Work Were Employed

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IN this article the writer will describe in detail the methods used in the excavation for the basement and foundations of two large reinforced-concrete factory buildings. These methods were adapted to the local conditions, and in some respects are special and peculiar, but may be generally utilized on similar works with slight modifications, even under different local conditions of soil, climate, topography, length of haul, depth of cut, shape and size of excavation and the like. Both buildings were built under close restrictions as to time limit and original estimate, and every effort was made in the planning and execution of the work to secure efficiency and economy.

Case 1—Steam-Shovel Excavation

A steam shovel was used in excavating for the first building, which is being constructed for the Dennison Manufacturing Company, of South Framingham, Mass. The building is rectangular in form, 70 ft. x 159 ft. 5 in., with two projecting stair towers and a toilet tower. The general plan of the building is shown in Fig. 1. There are to be a basement and four stories, and the girderless floor or mushroom system of reinforced-concrete construction is to be used throughout.

The west side of the building is nearly parallel to a public thoroughfare which winds around the south side, and this provides three points of access to the site. As the gate on the south side was used for the large traffic of the Dennison Manufacturing Company, however, it was not deemed advisable to use this gate in the excavation work for the passage of teams.

The soil excavated was a fine, clean, siliceous sand, in beds from 3 to 7 ft. in depth, and separated by strata of yellow clay, of a depth of 1 or 2 ft. The excavation was carried down to a gravel subsoil, upon which the footings were placed. The depth of excavation varied from 8.2 to 10.5 ft.

The excavated material was used to fill up two low, swampy tracts of land which were located about 1/3 mi. from the site of the building. This property belongs to the Dennison Manufacturing Company, and is being graded up for the building of houses for the company's employees.

Method of Excavation

A new Thew Automatic revolving steam shovel, type O, equipped with a 5/8-yd. dipper, was used for the bulk of the excavation. The manufacturers furnished an expert engineer who set up and operated the machine for several days, during which time he broke in a "green hand" as the runner. The latter operated the shovel without aid or supervision during the last ten days of the work.

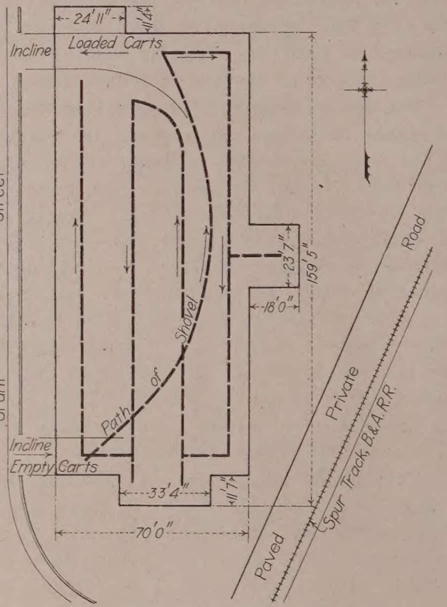


FIG. 1—PATH OF STEAM SHOVEL

The shovel began operations near the southwest corner of the building plot, and excavated a cut about 15 ft. wide on a descending grade of about 10 per cent. As the shovel approached the northeast corner of the plot it reached the finished grade, which was about 10.5 ft. below the original ground surface at this point.

Path of Shovel

The path of the shovel is shown by the dash line in Fig. 1. The east side of the excavation was completed first, as it was desirable to construct the footings and erect the basement column forms along this side, adjacent to the mixer plant and pouring tower, as early as possible. While the shovel was excavating in a southerly direction along the east side, a slip scraper was used to cut an inclined road from the north gate on Grant Street, along the north side of the plot, and curving and descending on a grade of about 6 per cent to the bottom of the excavation near the north end of the toilet tower. After the shovel had started on its second trip along the plot the wagons came in at the south gate on Grant Street, passed down the incline along the south side of the plot, around the east side of the shovel, where they loaded and passed up the north incline and out the north gate on Grant Street, to the dump. A view of the shovel loading a dump wagon is shown.

Support for Shovel

On account of the loose character of the soil and the inflow of water when the excavation reached grade, it was necessary to support the shovel on planking. A movable, sectional, platform was built of 4 x 8-in. timbers, bolted together to form sections 3 ft. wide and 12 ft. long. Four of these sections were used on straight stretches, and two triangular-shaped sections, half the size of the rectangular sections, were employed on the turns. Near the center of both ends of each section was placed a heavy iron eye by means of which the section could be shifted around with a chain attached to the dipper arm.

Neglecting time lost through breaks in

machinery, inclement weather, etc., the shovel was excavating about 60 per cent of the working time. Special effort was made to keep the shovel always supplied with wagons to load, and very little delay was occasioned from waiting for teams. From two to three shovelfuls were required to load each wagon to an average capacity of about 1 1/3 cu. yd. (loose measurement). On account of the looseness of the material, the average shovelful was about ½ cu. yd. Based on a large number of observations, the average time to make a complete dipper swing was 26 sec. and the minimum time was 18 sec. The average time to load a wagon, with three swings, was 1 min. 46 sec., and the minimum time was 1 min. 21 sec.

LABOR AND FUEL COSTS

The labor crew consisted of one foreman, one engineer, one fireman and two pitmen, or laborers. Following is a schedule of labor expenses per day of nine hours:

1 foreman at $6 per day	$6.00
1 engineer at $0.45 per hour	4.05
1 fireman at $0.30 per hour	2.70
2 pitmen at $2.03 per day	4.06
Total labor cost per 9-hr. day	$16.81

Water was supplied to the boilers through a rubber hose. Coal and coke were hauled thrice daily from a pile on the east side of the excavation and shoveled into a large wooden bunker built on the rear of the machine. The fuel cost for the operation of the shovel is as follows:

7 tons coal at $6.25	$43.75
1 ton coke at $6.75	6.75
Total cost of fuel	$50.50

The excavation was leveled up and made closely to grade by the use of a slip scraper, which was attached by a chain to the dipper handle. This work was done as far as practicable, during the short periods of waiting for wagons, at the beginning and end of each half day's work. The method of operating the slip scraper is shown in one of the illustrations.

The hauling away of the excavated material was done by rear dump carts hauled by two horses. These carts had a rated capacity of 1 cu. yd., and were generally filled by three dipperfuls to a capacity of 1 1/3 cu. yd. Care was taken to place the bulk of the load over the rear axle, so as to facilitate the dumping. From eight to fourteen teams were used and the latter number proved to give the most efficient operation of the shovel. The average haul was 1800 ft. The teams were run continuously in a circuit, and except for a short distance (about 200 ft.) the loaded teams were not allowed to pass the unloaded teams. Bunching of the teams was largely eliminated by careful supervision of the dumping and the movement of the carts along the road. A decided tendency to lag was noticed each day during the last hour of work. Some drivers would stop work during the last half hour if they thought that another load would take until after 5 o'clock to dump. In the morning several teams were usually late in arriving at the shovel for the first load. In order to eliminate these time losses, at the end of the first week's work a bonus of 25 cents was offered to each driver who made twenty-four trips per day. During the first day's work under the bonus plan one man made twenty-five trips, four men made twenty-four trips and seven others raised their previous day's record by one trip. After a study of this result a bonus schedule was established as follows: 25 cents per day per man for twenty-four trips; 40 cents per day per man for twenty-five trips; 50 cents per day per man for twenty-six trips.

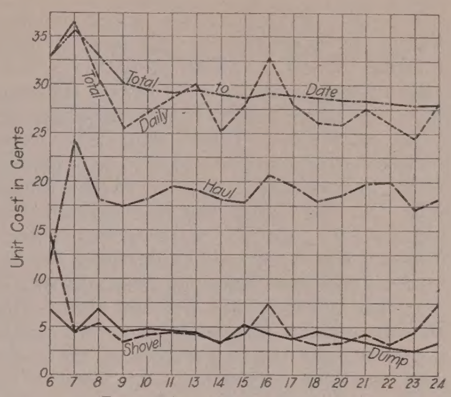


FIG. 2—SHOVEL, HAUL AND DUMP COSTS

TABLE 1—HAULAGE RECORD—STEAM-SHOVEL EXCAVATION OF BASEMENT FOR BUILDING FOR DENNISON MANUFACTURING COMPANY, SOUTH FRAMINGHAM, MASS.

Date, 1914	Number of teams	Total number of trips	Average number of trips per team per day	Total number of team hours	Average time per trip, min.	Yardage	Total yardage to date	Daily labor cost	Labor cost to date	Daily unit cost	Average unit cost to date	Remarks
July 6	..	62	...	22.5	...	83	83	$9.76	$9.76	$0.118	$0.118	
July 7	8	160	20.0	72.0	27.0	213	296	49.50	59.26	0.243	0.200	
July 8	10	227	22.7	90.0	23.8	304	600	55.00	114.26	0.182	0.190	
July 9	12	284	23.7	108.0	22.8	379	979	66.00	180.26	0.174	0.185	
July 10	12	271	22.6	108.0	23.9	361	1,340	66.00	246.26	0.182	0.183	
July 11	12	252	21.0	108.0	25.7	336	1,676	66.00	312.26	0.196	0.186	
July 13	12	257	21.4	108.0	25.2	343	2,019	66.00	378.26	0.192	0.188	
July 14	12	273	22.8	108.0	23.7	364	2,383	66.00	444.26	0.182	0.186	
July 15	13	304	23.4	116.0	22.9	369	2,752	65.38	509.64	0.178	0.184	
July 16	12.33[1]	247	20.0	111.0	26.7	329	3,081	67.82	577.46	0.206	1.187	25 min. delay—shovel off platform
July 17	13.67[2]	310	22.7	123.0	23.8	380	3,461	74.54	652.00	0.196	0.188	
July 18	13.90[3]	326	23.4	125.0	23.0	408	3,869	73.49	725.49	0.180	0.187	
July 20	12.60[4]	298	23.6	113.0	22.7	395	4,264	73.93	799.42	0.186	0.187	
July 21	13	251	19.3	104.0	24.8	335	4,599	66.50	865.92	0.198	0.189	Rain; 8-hr. day
July 22	14	309	22.1	126.0	24.5	412	5,011	82.75	948.67	0.200	0.188	
July 23	14	346	24.7	126.0	20.7	461	5,472	79.50	1,028.17	0.172	0.188	
July 24	5.35[5]	125	23.4	48.0	23.1	167	5,639*	30.42	1,058.59	0.181	0.187	Work ended 11 a.m.

[1] Based on 14 teams for 8 hr.

[2] Based on 14 teams for 5 hr. and 13 teams for 4 hr.

[3] Based on 14 teams for 8 hr. and 50 min.

[4] Based on 14 teams for 8 hr. and 5 min.

[5] Based on 12 teams for 4 hr.

*Total estimated excavation (place measurement) is 5095 cu. yd. The figures in this column based on each load being 1⅓ cu. yd., wagon or loose measurement.

TABLE 2—COST SUMMARY FOR SAME WORK

Date, 1914	Daily cost shovel excavation	Daily cost dump	Daily cost shovel repairs	Daily cost hauling	Total cost to date	Daily yardage	Total yardage to date	Daily total unit cost	Average total unit cost to date
July 6	$11.89	$5.63	....	$9.76	$27.28	83	....	$0.329	$0.329
July 7	18.79	9.69	....	49.50	105.26	213	296	0.366	0.355
July 8	16.56	20.72	....	55.00	197.54	304	600	0.303	0.329
July 9	13.41	17.17	....	66.00	294.22	379	979	0.254	0.300
July 10	15.45	17.18	....	66.00	392.75	361	1,340	0.273	0.294
July 11	15.41	15.71	....	66.00	489.87	336	1,676	0.287	0.292
July 13	14.84	15.47	$10.24	66.00	596.42	343	2,019	0.301	0.295
July 14	12.69	12.89	....	66.00	688.00	364	2,383	0.251	0.289
July 15	15.96	19.31	2.35	65.38	791.00	369	2,752	0.279	0.2875
July 16	24.55	14.24	1.35	67.82	898.96	329	3,081	0.328	0.292
July 17	15.50	14.24	2.49	74.54	1,005.73	380	3,461	0.280	0.290
July 18	13.23	18.51	1.57	73.49	1,112.53	408	3,869	0.261	0.2875
July 20	12.68	15.38	....	73.93	1,214.52	395	4,264	0.258	0.285
July 21	14.40	11.51	....	66.50	1,306.93	335	4,599	0.276	0.285
July 22	13.14	11.65	....	82.75	1,414.47	412	5,011	0.261	0.282
July 23	20.83	11.63	0.90	79.50	1,527.33	461	5,472	0.245	0.279
July 24	12.48	5.61	....	30.42	1,575.84	167	5,639	0.280	0.279

Item	Total cost	*Unit cost per cu. yd.
Labor at shovel	$262.31	$0.0515
Labor at dump	236.53	0.0464
Labor on roads and inclines	18.90	0.0037
Teams and hauling	1,058.59	0.2078
Superintendence, etc.	150.00	0.0294
Lumber for inclines, platforms, etc.	250.00	0.0491
Unloading, setting up, dismantling and loading shovel	179.05	0.0351
Rental of shovel	390.00	0.0765
Coal, oil, waste, repairs, etc.	66.60	0.0131
Total	$2,611.98	$0.5126

*Based on total computed excavation (place measurement) of 5095 cu. yd.

A study of the haulage record as given in Table 1 shows that the average number of trips per day per team for the last full day's work (July 22) was nearly twenty-five. Several teams made twenty-six trips per day.

TIME RECORDS

A timekeeper stationed near the building site kept a record of the time that each team entered the south gate and left the north gate. This record served to show the character and length of delays in the yard, such as loss of time in pulling up to shovel, and delay at the shovel. The dump foreman kept a record of the time of arrival of each team at the dump, and also of any delay in dumping and leaving the dump. The watches of the yard timekeeper and the dump foreman were synchronized daily. At the end of each day's work, the two records were compared and a study was made to determine the number, character, length and cause of all delays, the inefficient teams, the proper size and distribution of the load in the carts for efficient hauling and dumping.

The average length of haul was 1800 ft. The average time to make a round trip was about 21.5 min., and the minimum time was 15 min. Each of the two dump sites was a low, swampy basin which it was desired to grade up to the level of the adjacent streets. The fill at each site was made at two points simultaneously and was built out from firm soil by rear-dumping from platforms. These platforms were made of several sections of 2 x 12-in. planks 16 ft. long, cleated together on the under side. As the dump was carried out the sections of platform were moved ahead. Railroad ties were used as dumping blocks. To facilitate the dumping, especially when the sand and clay was wet and sticky, the drivers greased the main axle trunnions and salted the inside surfaces of the carts each morning before starting work. The depth of fill varied from 0 to 7 ft. The method of making the fill is shown on page 71.

The labor used in operating the dump during the first week consisted of a foreman, a sub-foreman and four laborers. This force was gradually reduced to a foreman and three laborers during the last four days of work. Thus an economy of 30 per cent was effected during the time that an increased output of 16 per cent occurred. The detailed information is given in Tables 1 and 2. Fig. 2 and Table 2 give a summary of the total daily and the unit costs for the various divisions of the work and the job as a whole.

The Aberthaw Construction Company, of Boston, is the contractor for the entire job. J. Arthur Garrod is the general superintendent, Fred S. Tucker is the local superintendent in direct charge, and the writer was in charge of the excavation.

Case 2—Drag Scraper and Hand Excavation

Drag scrapers and hand excavation were used in a building being constructed for the Stanley works, of New Britain, Conn. The building is rectangular in form, 63 ft. wide and 203 ft. long. The general plan is shown in Fig. 3. The plans call for a seven-story building, of the mushroom system of reinforced-concrete construction, without a basement.

The building site is a plot of ground surrounded by one-story frame structures, and until recently used for the storage of great piles of thin sheet steel. This plot was formerly a peat bog, which was filled in with ashes, cinders and slag from the power plant. Six test pits were dug to a depth of about 6 ft. below the general ground level, which was nearly that of the finished basement subgrade. The ashes and cinders made a top fill of about 2½ ft. in depth. Underlying this fill was about 1 ft. of peat, then about 3 ft. of red clay and then the foundation material of a dense shaly gravel. In places a large number of glacial boulders ranging in size from 1 to 4 ft. were found distributed through the gravel. At an average depth of about 7 ft. below the subgrade elevation water was encountered, and in some pits an inflow in the form of a steady, continuous stream took place.

The problem was peculiar and difficult in this case, since there was not to be a basement and the net excavation was the removal of sufficient material for the building of eighteen interior footings 15 ft. square and 6 ft. 9 in. below subgrade, twenty-two exterior footings 12 ft. square, and four corner footings 10 ft. square and 7 ft. 3 in. below subgrade. On account of elevator pits and a conduit tunnel-terminal, two interior column footings were carried to a depth of 10 ft. 6 in. and one interior and two exterior footings to a depth of 8 ft. 6 in. below subgrade. Allowing for the side walls, column stubs, and tunnel, the total gross excavation required was about 2500 cu. yd., with a backfill to subgrade elevation of about 1500 cu. yd. It is, therefore, evident that 1000 cu. yd. of material was to be permanently removed and wasted. After a preliminary study of the conditions it was decided to scrape off from the surface with two-wheel scrapers the 1000 cu. yd. of superfluous material, and then excavate the footing pits to grade with pick and shovel.

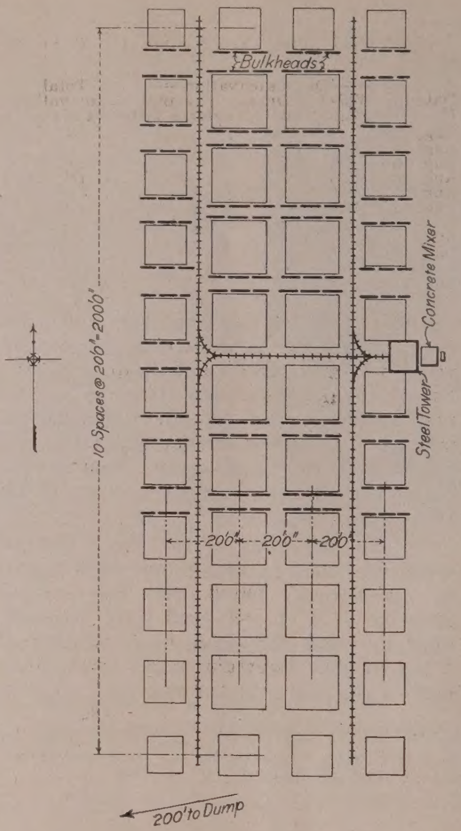


FIG. 3—ARRANGEMENT OF BULKHEAD

The cinder fill was found to be very dense and compact, and a two-horse plow was necessary to loosen up this material for the scrapers. Four, five and six two-wheel scrapers were used on consecutive days to remove this surface material from the building site to the dump, which was located about 300 ft. from the south end of the site. Hence the average length of haul was about 400 ft. Each scraper was operated by two horses and a driver, and no snatch team was used for loading, as the plowing up of the material rendered it loose enough to be loaded easily into the scrapers by the regular team alone. The net capacity of each scraper was ½ cu. yd. The average time for the round trip for the average haul was 4½ min. Two men were used to load the scrapers and two to dump and spread the material. A foreman supervised the loading, and a clerk at the dump kept a time record and superintended the dumping. Following is a schedule of the labor cost of the wheel-scraper work per nine-hour day:

1 foreman at $6 per day....................	$6.00
4 laborers at $0.25 per hour................	9.00
1 clerk at $10 per week.....................	1.67
6 teams at $0.60 per hour..................	32.40
Total	$49.07

Six scrapers gave the most efficient results and required the constant use of the plow for loosening. The average cost of excavation under these conditions was 25 cents per cubic yard. The local teamsters were inexperienced in wheel-scraper work, and strongly protested against the use of these machines. The writer believes that the use of the 1-yd. four-wheel scraper would have eliminated this discontent and inefficiency, and reduced the excavation cost to about 15 cents per cubic yard. This superficial excavation was made with an average cut of 1 ft. at the south and 3 ft. at the north end.

BULKHEADS BETWEEN FOOTINGS

If the hand-excavated material from the footing pits was shoveled into wagons, hauled away, dumped and then hauled again for the backfill, it was evident from the experience gained in digging the test pits that the cost would be excessive. Hence the writer devised the scheme of building wooden bulkheads between the footings. These bulkheads were made about the length of the side of each footing and were placed only on the transverse spaces between footings. This arrangement left open two continuous aisles or runways longitudinally, between the exterior and the interior lines of footing pits. (See Fig. 3).

Each bulkhead was composed of two parallel walls of 2 x 12-in. planks, placed with the 12 in. face vertical, and held in position by three bents composed of two 4 x 4-in. posts and cross-bracing at top and bottom. These bents were erected first and the planks added as the excavated material from the pits was piled up. A view is shown of the bulkheads during the early part of the excavation of the pits for the footings. The excavated material was shoveled directly into the bulkheads until they reached a height of about 4 ft. Then it became necessary to shovel the material to the surface at the open sides and reshovel into the bulkheads. The latter were often carried to a height of 8 or 9 ft., and were cross-braced with 4 x 4-in. struts across the pits. After nearly a week of continued heavy rains it became necessary to sheath and brace the loaded sides of the pits, as the clay became saturated with water and began to slide and cave in. This rainy season necessitated a great deal of extra pumping, although the inflow of underground water ordinarily began about 6 ft. below the subgrade elevation. The excavation of the four deep pits at the north end of the site required the removal of a large number of big boulders and necessitated almost constant pumping to remove the inflow of subsurface water. One gasoline power diaphragm pump and four hand pumps were used.

METHOD OF PROCEDURE

The excavation for the two end and the following eight interior footing pits was started first and carried down within about 1 ft. of grade during the erection of the pouring tower and mixer plant. As soon as the pouring of the concrete began the pits were carried down to grade consecutively, so that the concreting closely followed the excavation and both operations became continuous.

The narrow-gage track for the side-dump cradle concrete cars was laid along the two aisles or lanes between the adjacent rows of interior and exterior footing pits. A cross track was also run directly from the tower, connecting the two longitudinal lines of track. The latter were laid on a grade of about 0.5 per cent from the south to the north end of the excavation. As soon as the north footings were completed the surplus material from the southerly pits was loaded into concrete cars, moved down to the completed work and dumped into the pits for backfill.

The excavation of the exterior footing pits, at the north end of the site, was begun as the pouring of the adjacent interior footings neared completion. The excavated material from the upper sections of these side pits was shoveled directly into the center pits of completed footings. All backfill was thoroughly tamped in layers with a heavy iron hand tamper.

LOOSENING THE MATERIAL

Before the excavation of the footing pits in the south half of the site was started blasting was resorted to for the purpose of loosening the soil and thus reducing the amount of picking necessary. Each pit was blasted separately and the operation was as follows: Two laborers, equipped with a conical-pointed iron bar 1½-in. in diameter and a sledge, drove two holes about 4 ft. deep and from 6 to 8 ft. on centers on the axis of each pit. In each hole the blaster placed first a half-cartridge of 40-per cent dynamite, which he had previously slitted with a knife, and then another half-cartridge containing the exploder. From the exploder lead wires extended up out of the hole to the two main wires of the firing machine. A small amount of earth was tamped upon the top of each charge with a 6-ft. wooden rod. Each blast was protected with a heavy tarpaulin and several heavy timbers. The surface of the ground was but slightly heaved by the blast, but had the appearance of having been thoroughly churned. A crowbar was easily thrust down to its full length into the loosened soil.

The following is an estimate of the cost of loosening up about 500 cu. yd. of soil in twenty pits during a working period of five hours:

Materials		
20 lb. 40-per cent dynamite at 17 cents	$3.40	
40 exploders at $4.50 per 100	1.80	
		$5.20
Labor		
1 *blaster at $5 per day	$3.35	
2 laborers at 20 cents per hour	2.40	
		5.75
Total		$10.95

Cost of loosening 1 cu. yd. $10.95 ÷ 500 = $0.0219

*The blaster was an expert representative of a well known power manufacturer and furnished the firing machine, wires, drill rod and tamp rod.

TABLE 3—COST SUMMARY—SCRAPER AND HAND EXCAVATION AT STANLEY WORKS, NEW BRITAIN, CONN.

Date, 1914	Daily excavation: Wheel scrapers	Daily excavation: Drag scrapers	Daily excavation: Hand dump carts	Total excavation to date	Total daily cost	Unit cost: Wheel scrapers	Unit cost: Drag scrapers	Unit cost: Hand dump carts	Average unit cost to date	Total cost to date
Aug. 3	...	...	.....	.....	$11.72	....	....	....	....	$11.72
Aug. 4	...	...	.....	.....	31.61	....	....	....	....	43.33
Aug. 5	153	...	.....	222	49.78	$0.325	....	....	$0.419	93.11
Aug. 6	185	...	.....	407	53.15	0.273	....	....	0.359	146.26
Aug. 7	225	...	*32	664	63.80	0.247	....	$0.255	0.316	210.06
Aug. 8	130	...	*55	849	59.79	0.267	....	0.346	0.317	269.85
Aug. 10	...	...	.....	.....	....	....	....	....	....	289.85
Aug. 10	...	...	†75	924	32.89	....	....	0.438	0.349	322.74
Aug. 11	...	32	100	1,056	48.40	....	$0.304	0.387	0.351	371.14
Aug. 12	6	40	100	1,202	55.79	0.540	0.462	0.341	0.355	426.93
Aug. 13	16	43	23	1,284	45.94	0.612	0.456	0.730	0.367	472.87
Aug. 14	...	...	40	1,324	32.72	....	....	0.818	0.383	505.59
Aug. 15	...	...	35	1,359	34.64	....	....	0.989	0.400	540.23
Aug. 17	...	...	43	1,408	26.85	....	....	0.625	0.402	567.08
Aug. 18	...	...	55	1,463	39.62	....	....	‡0.721	0.413	606.70
Aug. 19	...	...	38	1,501	49.11	....	....	‡1.091	0.436	655.81
Aug. 20	...	...	47	1,548	81.43	....	....	‡1.732	0.476	737.24
Aug. 21	...	...	40	1,588	62.23	....	....	‡1.556	0.503	799.47
Aug. 22	...	...	55	1,643	105.20	....	....	‡1.906	0.550	904.67
Aug. 24	...	...	78	1,721	107.07	....	....	‡1.372	0.588	1,011.74
Aug. 25	...	...	115.2	1,836.2	121.15	....	....	1.050	0.617	1,132.89
Aug. 26	...	...	80.0	1,916.2	99.08	....	....	1.230	0.642	1,231.97
Aug. 27	...	..	123.0	2,039.2	123.45	....	....	1.000	0.662	1,355.42
Aug. 28	...	..	121.8	2,161.0	106.65	.. .	....	0.875	0.676	1,462.07
Aug. 29	...	...	25.9	2,186.9	62.74	....	....	¶2.420	0.696	1,524.81
Aug. 31	...	...	97.3	2,284.2	106.02	....	....	1.080	0.712	1,630.85
Sept. 1	...	...	103.5	2,414.7	102.34	....	....	0.785	0.718	1,733.17
Sept. 2	...	...	108.87	2,523.57	114.60	....	....	1.053	0.730	1,847.77
Sept. 3	...	...	112.5	2,636.07	123.20	....	....	1.095	0.748	1,970.97
Sept. 4	...	...	88.7	2,724.77	129.85	....	....	1.463	0.770	2,100.82
Sept. 5	...	...	71.27	2,796.04	82.28	....	....	1.152	0.780	2,183.10
Sept. 8	...	...	59.37	2,855.41	100.67	....	....	1.197	0.801	2,283.77
Sept. 9	...	...	20.8	2,876.21	65.66	....	....	§3.150	0.818	2,349.43
Sept. 10	...	...	2.78	2,878.99	60.73	....	....	§21.850	0.837	2,410.16
Sept. 11	...	...	1.50	2,880.49	37.01	....	....	§24.700	0.850	2,447.17
Sept. 12	...	...	6.22	2,886.71	51.60	....	....	§8.200	0.865	2,498.77
Sept. 14	...	...	6.00	2,892.71	7.75	....	....	1.290	0.867	2,506.52
Sept. 15	...	...	1.55	2,894.26	8.42	....	....	§5.430	0.869	2,514.94

*Carts.

†Hand.

‡Excavation of four deep pits at north end of site.

¶Excavation of 2 ft. of shale.

§Mostly backfill, of which no quantities are given or allowed.

The bulkheads of the northerly footings were taken down and moved to the south end of the site and erected for the storing of the material being excavated from the pits at that point. The spoil banks left after the removal of the bulkheads were spread uniformly over the spaces between the column stubs, and the whole area was brought up to the subgrade or elevation of the concrete first floor.

COST

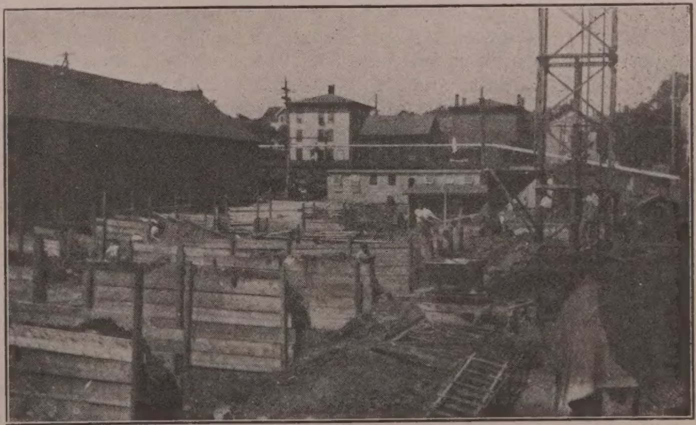
The detailed excavation cost is given in Table 3. This record does not include several miscellaneous items of contingent, office and overhead expenses, which when included bring the final average unit cost to $1.10. From Aug. 27 to Sept. 9 considerable backfilling was done and the record does not include any quantities for this work. This accounts for the high unit cost, especially on Sept. 9 to 12, inclusive, and on Sept. 15.

The six items marked with double daggers, in the third column from the right, include deep-pit excavation, which comprised the removal of many large boulders, the construction and removal of sheathing, and nearly continuous pumping with a 3-in. diaphragm hand pump for each one of the pit.

The Aberthaw Construction Company is also the contractor for this job. E. H. Temple, Jr., is the general superintendent, B. P. Floyd is the local superintendent in direct charge, and the writer was in charge of the excavation.

THE MÜNSTER GRENCHENBERG TUNNEL near Bern, Switzerland, was holed through on Oct. 27, 1914. The tunnel is 5⅜ mi., or slightly longer than the Hauenstein base tunnel, which was holed through July 10. The new tunnel is located north of the Lötschberg tunnel on the main route to Italy via the Simplon tunnel. Its construction has taken 3½ years and its cost is about $5,000,000. When the tunnel is put in operation the railroad line will be shortened 10⅝ mi. and the time of the journey lessened by forty minutes.

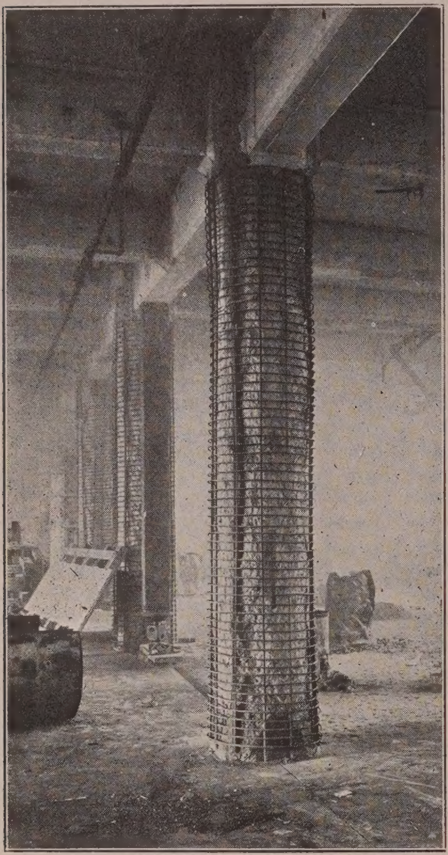
MAKING FILL FROM DUMP WAGONS USED WITH STEAM SHOVEL

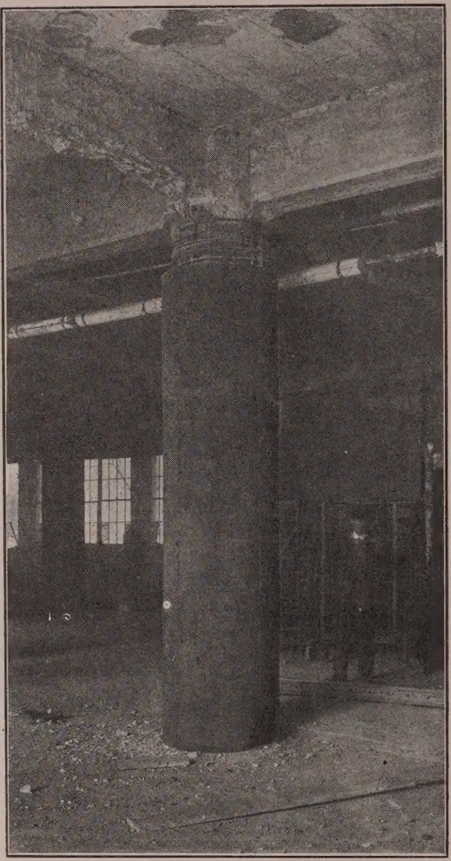


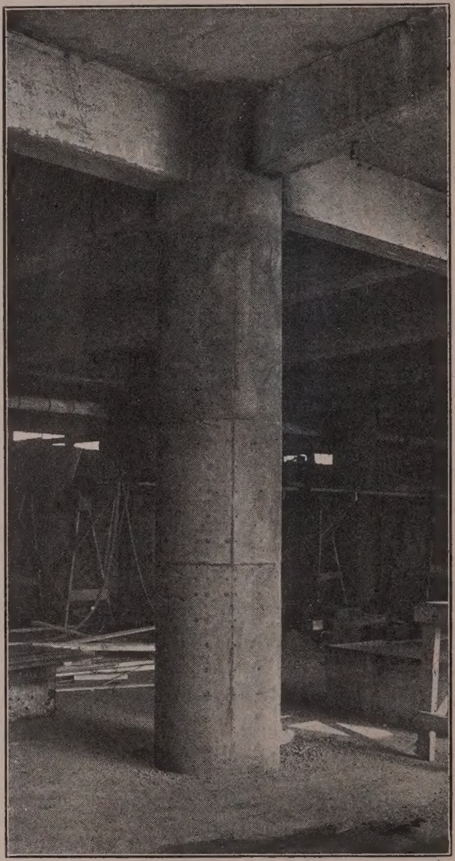
BULKHEADS USED IN THE SECOND JOB AT AN EARLY STAGE

Restoring Concrete Buildings at Edison Plant

THE plan for the reconstruction of columns in Building 24 of the plant of Thos. A. Edison, Inc., proposed by the Condron Company, of Chicago, was shown in the Engineering Record last week, page 40. In this issue, through the courtesy of T. L. Condron, are reproduced three photographs showing the various stages of the work on these columns. The first shows the square column chipped down to an approximately cylindrical shape and with the extra hooped reinforcement in place. The second photograph shows the column after the concrete has been deposited and the steel forms removed and the last shows how the finished column appears after its top has been completed with the use of the cement gun. No work has yet been done on the beams and girders and the design shown in the sketch in last week's issue will be modified.


CHIPPED AND WIRED COLUMN


COLUMN AFTER STRIPPING OF FORMS


APPEARANCE OF FINISHED COLUMN

INDUSTRIAL CONSUMPTION OF WATER IN DETROIT for the year ended June 30, 1914, was 36 per cent of the total 40,725,000,000 gal. pumped. In the report of Theodore A. Leisen, general superintendent of waterworks, it is stated that the per-capita consumption, based on 652,000 inhabitants, was 171.2 gal. daily, a decrease of 1.7 per cent over the previous year. If the industrial consumption is deducted from the total the domestic consumption becomes 111 gal. per capita per day, indicating, says the report, a wanton waste on the part of the consumers. The maximum hourly rate was 64 per cent above the average daily rate; it occurred Feb. 9, 1914, and was due to the attempt by house-holders to prevent the freezing of house pipes and fixtures. Only 0.08 per cent was used to put out fires.

Multiple Flowing-Through Chambers in Imhoff Tanks

Suggestions for Increasing Operating Efficiency—Deep and Shallow Tanks—Prevention of Scum—Hedges Around Tanks

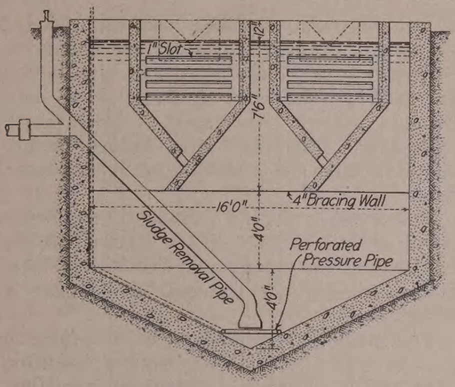
RECTANGULAR tanks with several flowing-through chambers over a common sludge digestion chamber have been suggested for Imhoff tank design by Prof. Charles Gilman Hyde in an article in "Pacific Municipalities." An installation of a large tank with three flowing-through chambers, based on Professor Hyde's suggestions, has been constructed at Chico, Cal., by Mr. Polk, city engineer.

In multiple flowing-through tanks there would apparently be no greater tendency for sewage to pass from sedimentation chamber to sedimentation chamber through the common sludge digestion chamber than there would be for an interchange of contents to take place between a single flowing-through chamber and the sludge digesting chamber beneath it. Experience has demonstrated, according to Professor Hyde, that such a tendency, if it exists at all, is very slight and does not require special consideration. Theoretically, of course, due to relative temperature changes, such an interchange of liquids might take place. Where several sedimentation chambers in a single unit are proposed great care must be taken to proportion accurately the flow of sewage between them by the use of suitable and sufficient inlet and outlet devices. Such devices, it is believed, can be readily arranged. It should be remembered that the greater the width of such sedimentation chambers, the greater their depth must necessarily be and the greater will be the volume of ineffectual space in the scum chambers above the level of the slots. The use of multiple sedimentation chambers may often permit of their better proportioning and greater effectiveness.

DEEP AND SHALLOW TANKS

Relative to deep and shallow tanks where land is comparatively cheap and where climatic conditions for the drying of sludge are very favorable, as is notably the case in California, Professor Hyde is inclined to believe that shallower depths than have been employed in Germany may be used with satisfaction and may represent a real total economy. It would appear that tanks from 16 to 20 ft. in total depth can be satisfactory, provided that, in their design, proper account is taken of the greater average volume of sludge which will obtain with a given weight of dry solids in the shallower tanks as compared with the deeper tanks, to which most of the data now available relate.

In California, because of extreme biological activity, unscreened sewage ordinarily decomposes very rapidly, forming large volumes of gases which lift the particles and produce scum instead of sludge. In some cases the amount and nature of the scum formation has represented a most troublesome feature of operation of septic tanks of the Cameron type and of Imhoff tanks. It is important that scum chambers be of generous horizontal area, perhaps at least 15 per cent of the total superficial area of the sedimentation chambers. They should be perfectly accessible so that the scum may be frequently broken up with a view to liberate the entrained gases and permit the solids to settle to the bottom where proper digestion may take place. If this is not done very troublesome amounts of scum may be formed and, under extreme conditions, practically the entire weight of solids deposited in a tank will be lifted into



DOUBLE CHAMBERED IMHOFF TANK

the scum chambers and will collect to a depth which will be limited only by the dimensions of the tank.

While sludge-drying beds in Germany are proportioned to provide 330 sq. ft. per 1000 persons represented by the tank capacity, the area required on the Pacific coast where the dry periods are prolonged, sludge bed areas may be reduced to a minimum of 250 sq. ft. per 1000 persons.

HEDGES AROUND TANKS

From the aesthetic standpoint, Professor Hyde points out, a screen of trees or a hedge around the site of an Imhoff tank installation would be much better than covers. In the first place a hedge of one of a dozen available plants would be infinitely more artistic than any cover could possibly be. If such hedges were allowed to grow up quite high they would aid in diffusing any possible odors generated by the plant. Well-ordered hedges would do much to allay the suspicion of neighbors and passers-by while a board fence or a cover would tend to arouse their suspicion. The psychological side of the problem of nuisances and offense to the public is extremely important and should receive particular attention in certain cases. There is no excuse for unsightliness, even in connection with such commonplace things as sewage treatment plants.

Pere Marquette Worth $78,545,241

According to the appraisal of the Pére Marquette Railroad recently completed by Prof. M. E. Cooley, dean of the engineering department of the University of Michigan, the property is worth $78,545,241. This allows $18,417,531, or nearly 20 per cent, for depreciation, the reproduction cost new being estimated at $96,962,771. Per mile the figures are respectively $45,392 for reproduction new and $36,770 for reproduction less depreciation.

This is Dean Cooley's fourth appraisal of the road in fifteen years. In 1900 he made a hurried evaluation of all the railroads in Michigan, for taxation purposes. The second appraisal was made in 1902 and the last previous one in 1905. The 1914 estimate of value exceeds that of 1905 by nearly $30,000,000, with only a very slight increase in mileage. This is explained partly by the fact that much more time and care were given to the 1914 appraisal; partly by the numerous additions and betterments, such as the replacement of wooden bridges with steel and of light rail with heavier sections; and partly by the increases in value of various elements, notably right of way and other land, grading, ties and equipment.

Chicago's New Tunnel and Pumping Station Part of Comprehensive Waterworks Plan

Part I—Important Extensions and Improvements of System, Seen by City Engineer in 1905, Are Being Built to Serve Needs of Increasing Population

By HORACE S. BAKER
Assistant City Engineer, City of Chicago

A GROWING public service company or municipal enterprise must develop according to an orderly plan. This plan must be based upon the future needs of the population to be supplied, as far as they can be predicted. The main lines of growth can usually be foreseen for a period of 10 to 20 years and sometimes longer, but the exact methods of development cannot usually be planned for more than 4 or 5 years in advance, and sometimes it is impossible to lay down exact steps to be taken even that far ahead.

During its early history the Chicago waterworks grew by annexation and purchase without any definite plan. In this way it attained a considerable magnitude, although the plans and construction of those early days are found to have been in many cases so exact and far-sighted that the modern engineer must look on them with great respect.

EXTENSIONS FORESEEN IN 1905

In 1905 a report was made by John Ericson, city engineer, outlining the growth of the system up to that time, and laying down certain exact steps for extension of the system, which it was estimated would be completed in 1909. Further extensions were mentioned which would have to be carried out at a later date. The steps which were to be taken immediately have all been completed. The Roseland pumping station and the southwest land and lake tunnel, which were estimated to be completed in 1909, were actually put in service in 1911.

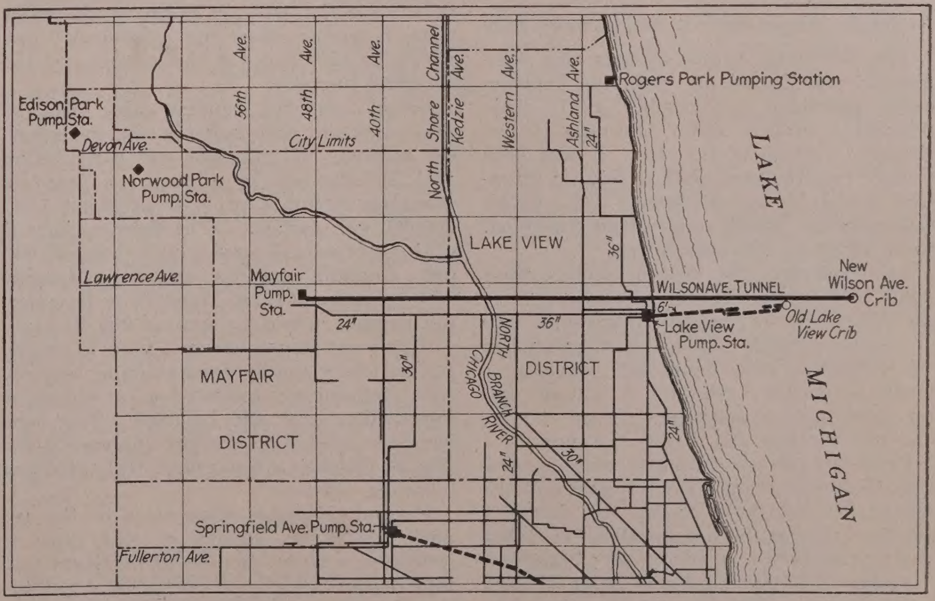
Certain future extensions of the water supply system were the Devon Avenue system of crib, tunnel, pumping station and distributing mains, the Sixtieth Street system, including the same items, and the Roseland system, including additional machinery of 50,000,000 gal. daily and certain additional large mains.

Of these three systems the Roseland work is now being done, viz., the two additional engines are being erected in the pumping station, and the greater part of the mains have already been laid. The Devon Avenue system has been changed in location so that the tunnel is located in Wilson Avenue, and will supply a pumping station at Mayfair. This tunnel is now under construction, and work will be started in the near future on both the crib and the pumping station. The Sixtieth Street system has not yet been started, but it is planned to make that the next extension of the system. The plan has been considerably modified, however, as it will probably be more advantageous to locate the station about ½ mi. farther south and to draw its water supply from the southwest land tunnel system by a connecting tunnel extending to State and Seventy-third Streets.

FINAL DEVELOPMENT PLANS

In 1906 the city engineer and William S. MacHarg, consulting engineer, prepared a plan for the final development of the entire water distribution system, including all mains to be laid over 12 in. in diameter. This plan has formed the basis of subsequent extensions of the system, being modified to fit local conditions. In 1911 the city engineer prepared a report on the water supply system of the city containing a recommendation for immediate improvements and future extensions of the system. To a large extent these recommendations have already been carried out as follows:

A new boiler plant and additional pumping engines were recommended for Chicago Avenue pumping station. This work was not started, as it was found that by overhauling the old boiler plant it could be made to give several years more of service, and this was done. It will soon be necessary, however, to provide a new boiler plant at this point and to provide additional pumping capacity. On account of the high load



SECTION OF CHICAGO SUPPLIED BY WILSON AVENUE TUNNEL SYSTEM factor on the stations at Fourteenth Street, Harrison Street, Springfield Avenue and Central Park Avenue, it was recommended that a 25,000,000 gal. steam, turbine-driven, centrifugal pump be erected in each of these stations as a reserve unit, together with certain necessary boilers and other auxiliaries. These pumps have all been erected and are now in service, and have provided a great help in the operation of the stations.

New Pumping Stations

The city engineer's recommendation of 1905 for the addition of two 25,000,000 gal. engines at Roseland pumping station was repeated, and this work is now nearly complete.

It was recommended that three new triple expansion pumping engines be installed in Lake View pumping station, together with a new boiler plant, and that during the construction of the new engines two 20,000,000 gal, electric, motor-driven, centrifugal pumps be installed to maintain satisfactory pressure until the new engines could be put in service. Upon further investigation it was deemed advisable to use steam, turbine-driven, centrifugal pumps rather than electric, motor-driven pumps, and a temporary boiler plant was constructed and two steam-driven, centrifugal pumps installed in the station. They were so located that they could be operated until the new vertical pumping engines could be erected and ready for service. This was done, and they maintained a satisfactory pressure while the old engines were removed and the new engines were being erected. Three of the new engines are now in service, and the fourth is ready for erection. The temporary centrifugal pumps have served their purpose and have been removed to the Sixty-eighth Street pumping station, where they have been erected to take the place of some of the worn-out pumping machinery. The new boiler plant is well under way at Lake View pumping station, and should be practically completed by the end of this year. It was recommended that an entire new pumping station be installed at Sixty-eighth Street station. This work has not been started as yet. The boiler plant at Sixty-eighth Street is a first class, modern plant, and the old engines have been well maintained, so that with the addition of centrifugal pumping units they will probably be of service for some time yet.

Averting Shortage on Northwest Side

The southwest tunnel system was completed, and Roseland pumping station began operating in December, 1911. This relieved a serious water shortage in the southern portion of the city. It was seen at once that the next district to need attention would be the northwest side, which was growing rapidly and where occasional water shortage was already felt.

In developing the design studies were made to determine limits and character of the district to be supplied; maximum rate of water consumption per unit of area when the district is fully developed; capacity of pumping station; location of station; determination of location and design of crib, and size, location and details of tunnel.

For the purpose of study it was assumed that the present Lake View tunnel and the new Wilson Avenue tunnel will have to supply a rectangular area of 48 sq. mi. lying north of Fullerton Avenue, east of the west boundary of the Sanitary District, and south of the north line of the city. As designed the tunnel alignment is slightly north of the center line of this area.

The surface of the Mayfair district rises gradually to the west from about 20 ft. above city datum to 50 ft. above datum near Sixty-fourth Avenue. The ground west of the 50-ft. contour reaches a maximum height of 70 ft. above datum. The territory above the 50-ft. contour is designed to be supplied by pumps operating against 200-ft. head, while the territory below the 50-ft. contour will be supplied by pumps operating against 140-ft. head, and the mains will be connected with the general distribution system.

It was assumed that the general occupation of this district would be ultimately an average dwelling or residence district with occasional factories and minor mercantile districts.

The limits of the district as above described were determined by a consideration of the location of present stations, their ultimate capacity, and the topography and past growth of population.

Rate of Water Consumption

To determine the probable final rate of water consumption within the area assumed, a study was made of data compiled in connection with water waste surveys in Chicago. The results of these surveys show that the average density of population in built up districts of similar character was fifty-four persons per acre, and 191 gal. per capita was the average daily consumption. It was assumed that the final population of this district would average forty persons per acre with a maximum rate of water consumption of 300 gal. per capita. At this rate there would be required about 8,000,000 gal. per square mile, which was used for designing purposes. The assumed rate of 300 gal. per capita seems high, but it must be remembered that the Chicago system employs direct pumpage without reservoirs and it is necessary, therefore, to figure on peak loads. If metering can be brought about it will be possible to maintain pressure with a lower rate of pumpage, thus allowing a more gradual growth of the system and its ultimate extension over a larger territory.

The quantity of water ultimately required in the area north of Fullerton Avenue is assumed to be 384,000,000 gal. per day. As the maximum consumption in all parts of the district will not occur at the same time, it was assumed that 350,000,000 gal. would be sufficient for the capacity of the crib and tunnel.

Calculations for general cases and for this particular case indicate that the greatest economy of pumpage and distribution will be attained by giving the Mayfair pumping station a capacity of about 150,000,000 gal. per day. The final equipment of this station will consist of four 25,000,000 gal. pumping engines operating against 140-ft. head and three 17,000,000 gal. pumping engines operating against 200-ft. head.

Triple expansion, vertical, triplex, single-acting, crank and flywheel pumping engines with mechanically operated water valves of the Riedler type will be used. This type has been used with marked success by the city at Chicago Avenue and at Lake View pumping stations.

Careful estimates were made of the annual costs of a station of this type as compared with an equipment of steam turbine-driven centrifugal pumps, and the figures showed a small advantage in favor of the centrifugal pumps. It was deemed advisable, however, to adopt the conservative course of adhering to the type which has proved successful under Chicago conditions and to experiment further with centrifugal pumping units before recommending them for adoption on such a large scale.

The location of the station is somewhat north of the centre of the district to be supplied, at Lamon Avenue and Wilson Avenue, adjoining the Chicago, Milwaukee & St. Paul Railway.

The principal requisites of a pumping station are: Good water supply; location near center of gravity of load, and railroad connection. Wilson Avenue affords a direct route for the tunnel from the lake to the station site, and the rock is of good quality for tunneling. Therefore, the good water supply can be secured. The location is near the center of the district to be supplied, and has a good railroad connection.

Location of Crib

The crib is to be located on the line of Wilson Avenue produced about 3 mi. from shore in about 35 ft. of water. Records of water samples were carefully studied, and no definite line could be determined beyond which pollution could be avoided, but they did indicate that the best water is obtained from the cribs located farthest out in the lake.

The first report of the Lake Michigan Water Commission describes the taking of many samples at various distances from shore. The observations led to the conclusion that within 2 mi. of shore the water was almost constantly polluted, and at a distance of over 3 mi. from shore it was only occasionally contaminated. Contamination is widely distributed under certain wind conditions, and pollution from lake vessels will be possible anywhere in the path of such vessels until proper regulations for disposal of sewage from such vessels are adopted by Congress. It is not possible to avoid turbid water in times of heavy storms at any practicable distance from shore on the line of Wilson Avenue or anywhere off the shore of the city of Chicago. The records do not show increased bacterial contamination accompanying such turbidity. It is reasonable to expect that out of the zone of shore pollution practically pure water will be secured. The location was, therefore, fixed at 3 mi. from shore.

The design of this tunnel system has been made under the direction of John Ericson, city engineer, M. B. Reynolds, engineer of waterworks design, and the writer. All the construction work, both contract and day labor work, is under the immediate supervision of Henry W. Clausen, engineer of waterworks construction.

(*To be concluded*)

A Valuation of Dayton's Water Supply from an engineering standpoint has been nearly completed by Pollard & Ellms, consulting engineers. From preliminary sheets, subject to correction, the city has spent $2,740,000 on the plant and the consumers have spent $550,000 for service connections. The replacement cost is estimated at $2,500,000 and the present value, based on original cost depreciated for parts abandoned, obsolescence and wear and tear, is $2,300,000. Based on replacement cost depreciated the value of the plant would be $1,850,000.

Development of Water Power on Public Lands

Abstract of Part of the Testimony Given at the Hearings on the Ferris Bill Before the Senate Committee on Public Lands

HEARINGS were held in December by the Senate committee on public lands on the Ferris bill, which aimed to establish new regulations for the development of hydroelectric power on the public domain. The testimony of Hugh L. Cooper and W. V. N. Powelson, of New York, and of John A. Britton, of San Francisco, seemed especially pertinent and the important parts are, therefore, abstracted herewith. In general the objections to the measure were leveled at the 50-year lease clause and at the provision that not more than 50 per cent of the power might be sold to one consumer, while much evidence was offered to show that hydroelectric development had not been very profitable and that they were finding difficulty in competing with steam power.

VIEWS OF W. V. N. POWELSON

W. V. N. Powelson, consulting engineer, of New York, said that the proposed legislation should accomplish three main purposes—first, the delivery of power to the public on the lowest possible terms; second, delivery under conditions that insure the greatest reliability of service; third, delivery of power in the greatest volume that the market can absorb, that is to say, cheap power, good power and all the power that any one can use. If the legislation accomplishes those three main purposes, it has done all that the public interest could expect or require.

Senator Clark asked whether there should be some obligation upon the Government to grant the permit if the regulations were fulfilled by an applicant. Mr. Powelson said that he was absolutely in accord with that proposition because he thought that it would make money less expensive. Anything that makes financing expensive will increase the cost of energy. Between 80 and 90 per cent of the cost of generating waterpower is made up of fixed charges. Operating expenses are therefore substantially negligible. The proposed prohibition to limit the amount of energy to be sold to any one customer to 50 per cent of the total output would tend to retard development.

VIEWS OF HUGH L. COOPER

Hugh L. Cooper, consulting engineer, of New York, said that the water-power business in general has suffered greatly in respect to profit from two very great opposing natural difficulties. The first is that the water-power business, as applied to hydroelectric work, is a new art, being scarcely over 20 years of age. In the last 10 or 12 years plants with a capacity of more than 600,000 hp built upon navigable streams and upon public-land permits have been absolute financial failures to the extent that the investors therein cannot be appealed to again for the support of similar investments. In general, the water-power investments have not been a success up to date. The list of plants given by Mr. Cooper is shown in the accompanying table.

Hydroelectric securities are very unpopular in the American market. A large amount of hydroelectric securities have been sold in Europe, but the war has closed this field completely. Practically all of the $16,000,000 bonds for the Keokuk (Ia.) enterprise were placed abroad.

The next difficulty in the way of water-power investment is the very serious one of steam-power competition. The water-power engineer has met everywhere each six months some new invention to bring down the cost of steam power. When Mr. Cooper first went into the business $125 was a good, fair estimate of the capital cost per horsepower for a complete steam plant, and to-day it is $40. The steam engineers have not been content in reducing the cost on the capital side but have increased the efficiency of their steam units so that the amount of coal consumption per horsepower is less than one-half what it was 15 or 20 years ago. Furthermore, the steam generating stations of to-day require much less repair, much less oil, much less labor than used to be the case. Steam power with all charges paid does not cost more than 40 per cent of the cost 15 or 20 years ago. The waterpowers of the United States that have to compete against the steam energy have been constructed at an average cost of about $160 per horsepower. Mr. Cooper emphasized the fact that he meant real dollars instead of stocks or bonds.

PARTIAL LIST OF WATER-POWER DEVELOPMENTS WHICH HAVE EITHER BEEN THROUGH RECEIVERSHIPS OR PROVED BAD INVESTMENTS

	Hp
Hudson River, Spiers' Falls, N. Y., Mechanicsville, N. Y.	52,000
Michigan Lake Superior Power Company, Sault Ste. Marie, Mich.	23,000
Great Shoshone & Twin Falls Water Power Company, Pocatello, Idaho	10,000
Animas Power & Lighting Company, Durango, Col.	4,500
Central Colorado Power Company, Denver, Col.	40,000
Wisconsin Railway, Lighting & Power Company, Hatfield, Wis.	8,000
McCall Ferry Power Company, McCall's Ferry, Pa.	80,000
Hanford Irrigation & Power Company, Priest Rapids, Wash.	4,000
Yadkin River Power Company, Rockingham, N. C.	25,000
Hauser Lake (Mont.) Power Company	15,000
Chattanooga & Tennessee River Power Company, Chattanooga, Tenn.	40,000
St. Lawrence River Power Company, Massena, N. Y.	60,000
Austin Dam, Texas	25,000
Stanislaus Electric Power Company, San Francisco	50,000
Whitney Plant, on Yadkin River	20,000
Miscellaneous Small Water-powers	50,000
Alabama Power Company	70,000
Appalachian Power Company	40,000
Total	616,500

The present cost of the Keokuk plant is about $175 per horsepower. When the present possible output is all sold and the rest of the power is developed the cost will be about $120 per horsepower. The average capital cost per horsepower at Niagara Falls is about $110. Some recent extensions there have brought the average cost down. Mr. Cooper said that the average cost by steam in the vicinity of the Keokuk plant would be $24 or $25 per horsepower. The energy is sold in St. Louis at $18 per horsepower per year. Mr. Cooper presented a table showing that since March 2, 1909, new water-power plants constructed and operated on national forests and founded upon revocable permits have aggregated 15,520 hp. Outside of the public domain since 1909 plants with a rating of over 700,000 hp have been built.

CONSERVATION

To illustrate his views on conservation, Mr. Cooper drew an analogy between the waste of water power and the wanton burning of a pile of coal representing the same value as the water running to waste. It had been stated at the hearing that there were about 60,000,000 hp still to be developed in the United States. Without agreeing or dissenting with this statement, Mr. Cooper thought the resulting comparison startling enough, if only one-fourth of this figure, 15,000,000, were assumed. On the basis of 10 tons of coal per horsepower, the development of 15,000,000 hp would save 150,000,000 tons of coal each year, valued at $300,000,000. Suppose that instead of trying to conserve this coal, a huge pile of it were burning out on the prairies, literally destroying $300,000,000 of value each year. How long, Mr. Cooper asked, would it take Congress to frame a bill that would allow somebody to go out there and put out the fire?

VIEWS OF JOHN A. BRITTON

At the hearing, John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, San Francisco, made an extensive statement on the situation as seen by the management of a large power company in the territory affected by the legislation.

The beginning of the present Pacific Gas & Electric Company system was in a small 3000-hp plant; now the output is practically 200,000 hp. That development was made possible by rates that were comparable with costs of coal energy in the earlier days and subsequently energy from oil. California has been developed to its present industrial importance entirely through the development of hydroelectric plants and the resultant cheapening of power. It is as prosperous as it is by reason of cheap hydroelectric power. Rates in California for lighting, heating and motor service are lower by practically 50 per cent than in any other state with which Mr. Britton is familiar and lower by far than anywhere in the Eastern States except perhaps in instances governed by the Niagara development.

Mr. Britton prophesied that the time is not very far distant when the cost of hydroelectric generation and transmission to central points and the cost of steam generation and transmission will meet and cross, and that by reason of cheaper fuels owners of plants in a great many states will reduce the point of economical steam generation by locating where water can be obtained for condensation purposes, and steam will become a cheaper prime mover for the generation of electrical energy than will the falling waters of the streams. Formerly steam plants consumed 30 to 35 lb. per horsepower hour; now modern plants use 9 to 9½ lb.

Regarding rates Mr. Britton stated that the California public service commission had found that the average rate for energy delivered to the substations in the district was practically 7.3 mills per kilowatt-hour. Steam power had been generated and delivered practically under the same conditions for less money where the efficiency of great turbines has been utilized on a high load factor.

FIFTY-YEAR PERMIT PROVISION

Speaking particularly about the bill, Mr. Britton said that the provision limiting the term of permit to a period not longer than 50 years would prevent the financing of any future project of this character. When rights are liable to be terminated at the will and pleasure of the Government there would be no means by which the proper investments made on behalf of an enterprise could be returned. If the term is certain and known, there is a possibility that provision may be made for the proper return of the capital investment.

The period ought to be fifty years and thereafter until terminated through some action of the Government in taking the property over for its own benefit for purely public purposes and not for the purpose of going into competition with other companies operating in the same field. The rights ought to be practically in perpetuity, because if a company operating an investment of this character for 50 years under proper State regulation gives a service to the public that is high in class and reasonable in rates it ought to be permitted to continue unless the Government requires for some public purpose to acquire the plant. The term ought not to be less than 50 years, because in the present progressive state of the science of electric distribution no man can say what will happen.

Progress of the Art

If the door can be unlocked and regulation provided that will prevent monopoly, Mr. Britton believes that the securities of companies will sell at very much higher figures; the higher the figures the less the public will have to pay finally for the properties. Mr. Britton also said that he did not favor the clause providing that the chief officer of the department under whose supervision lands may be shall have the right to determine whether or not they shall be used for the purpose contemplated. In his judgment the bill ought to set forth specifically the form of lease with all the conditions pertaining thereto. The clause which provides that at no time shall any lessee deliver to any consumer electric energy in excess of 50 per cent of the total output Mr. Britton characterized as absurd.

In the development of electrochemical processes the country will be dependent largely on the economical utilization of undeveloped water-powers. Recently Mr. Britton had a call from an engineer from Norway who asked for a rate on 100,000 hp or more so that a plant for the manufacture of the nitrates could be established in California. There are developments now under way in California at different points where it will be possible for the greater part of the output to be consumed by an industry of that character which uses the energy 24 hours a day and 365 days in the year. The ultimate interests of consumers will be served by that arrangement. It will enable the plant to sell the remainder of its supply of energy at a very much lower rate.

Value of Electrochemical Process

The load-factor of the Pacific Gas & Electric Company has been built up from practically 12 per cent in 1903 to 70 per cent now. The electrochemical process which is now being used so well in Norway and is so greatly encouraged in that country and in Canada is going to be one of the saviors of hydroelectric power and the beginning of low rates for energy generated in that way, and will perhaps change the tendency Mr. Britton mentioned, so that hydroelectric energy will continue to be below steam energy in cost of production.

In the early days, where the development of hydroelectric energy was in small units of 1200 hp, necessarily the cost per unit was very much greater than it is to-day. Water-power cost in those early days about $300 per horsepower for installation. The Pacific Gas & Electric Company developed a plant not very long ago at a cost of $51 per horsepower, but the conditions were very favorable. The cost will run between that low price and $150 or $200 per horsepower now. If a company wants to sell 75 or 90 per cent of its output to one consumer, it is in the interest of the consuming public that that should be permitted.

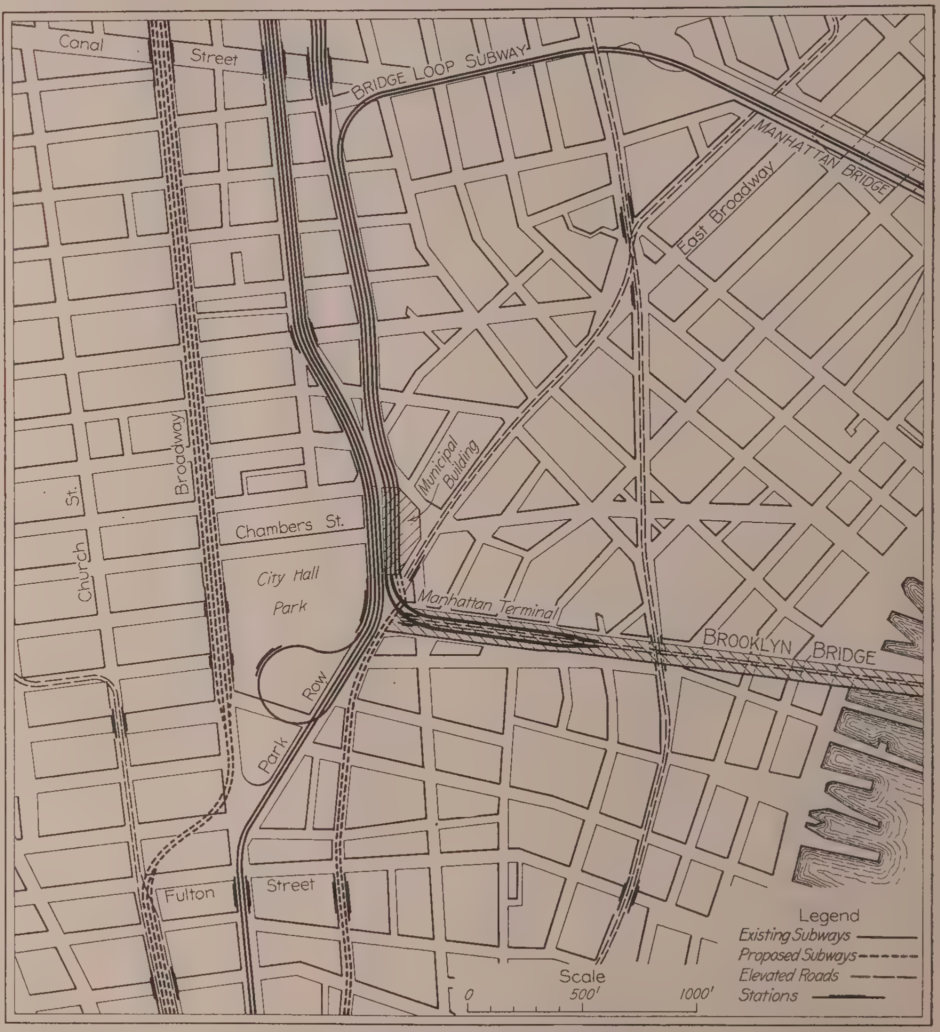
Mr. Britton objected on economic grounds to the clause relating to the physical combination of plants or lines. He spoke of the purchases of energy made by the Pacific company from other companies in California. The various plants are tied together, and it is wise from an economic standpoint that this should be so. If it had not been for this arrangement, some of the companies would have been without energy for their customers at times. With State regulation there is no reason why the companies should not be tied together for the protection of the service and the public.

Brooklyn Bridge Subway Connection, New York City

Difficult Removal of Large Quantities of Massive Concrete for Construction of Inclined Tracks in Manhattan Terminal

CONNECTION of the bridge-loop subway tracks in New York City with the elevated railroad system crossing the Brooklyn Bridge involved the construction of a final link consisting of two tracks about 1500 ft. long, ascending 71 ft. from the subway level at the Municipal Building to the bridge floor and intersecting the first and second floors of the terminal station. This necessitated cutting through a large amount of concrete and brick masonry in the massive arches and in the main floor of the bridge approach, crossing all of the terminal loops of the surface railroads, underpinning many columns carrying the second-story platform and elevated tracks, removing a large quantity of concrete without blasting, and erecting new steelwork without interrupting or endangering the incessant congested traffic.

The main floor of the inclined approach is of massive construction, consisting chiefly of twenty-seven heavy concrete arches with brick soffits. Their spans are about 30 ft. and their axes are transverse to the axis of the bridge. Three intersecting streets are cleared by arches of much longer span and Franklin Square is crossed by a steel truss deck span of about 180 ft. The original floor is at a grade of 3.75 per cent and the new tracks are graded 5.454 per cent, thus making a slight angle with the old floor. The two new tracks are arranged symmetrically with the longitudinal axis of the bridge, and involved cutting through partly or wholly all of the old arches and piers and passing through the warehouses which occupy the space below the bridge floor. Each track is carried in a sort of canal 12½ ft. wide in the clear, and of varying depth below the bridge floor, which, where the head-



LOCATION OF ENDS OF BRIDGES, PRESENT AND PROPOSED SUBWAYS AND NEW LOOP

REMOVING OLD ARCHES OF BRIDGE TO MAKE ROOM FOR SUBWAY CONNECTION

room is sufficient, is supported over the canal on steel beams and girders inclosed in concrete. The sides of the canal are faced with 8-in. concrete walls bonded into the old masonry that was cut away to receive it, and supported on longitudinal I-beams. The ballasted track is carried on a reinforced-concrete platform seated on the top flanges of longitudinal plate girders completely inclosed in concrete.

METHOD OF CUTTING OUT MASONRY

The cutting out of the old floor and arch masonry to receive the new tracks involved the removal of about 4000 cu. yd. of concrete and 9000 cu. yd. of brick masonry from 2 to 8 ft. thick. Work was begun at the river end, and progressed simultaneously on both sides of the bridge in sections 100 ft. long, with about fifty men at work at each end and in the middle of each section. These sections were securely fenced off to divert traffic and nine McKiernan-Terry B-1 hammer drills run by compressed air were installed at each of the four working places. No explosives were used. The drills were generally fitted with drill points and removed about 2 cu. yd. in one eight-hour shift. Sometimes, however, in brick work, it was possible to loosen a whole course and remove larger quantities at a single operation. Power was supplied by one electrically-driven Ingersoll-Rand air compressor with a capacity of 600 cu. ft. of free air per minute delivered through a 4-in. main at a pressure of 100 lb. per square inch.

The spoil was removed in wheelbarrows to dump cars on the tracks and aggregate for the concrete was delivered in carts to storage piles in the street and wheeled to three Ransome mixers, from which concrete was taken in wheelbarrows to the forms. For straight work 2000 sq. ft. of 2 x 5-ft. Blaw steel units were used and for curved work wooden forms were employed.

UNDERPINNING COLUMNS

About 160 steel columns with 119-ton loads were underpinned on permanent transverse plate girders from 14 to 30 ft. long and 5 to 7 ft. deep. The heaviest girders weighed 19 tons each and considerable skill and patience were required to handle them through the heavy traffic, often where small clearances precluded the use of derricks. To permit the removal of their original supports and the insertion of the new girders, the columns were shored on pairs of 12-ton horizontal longitudinal plate girders 60 ft. long and 5 ft. deep, with transverse beams on their top flanges engaging the bottom flanges of wide steel brackets temporarily riveted across the faces of the columns. The column loads were transferred to the shoring girders by pairs of steel wedges.

Where the new tracks cut through the haunches of the Rose Street arch they are carried by through plate-girder spans with bearings on piers built from the arch skewbacks.

A difficult part of the work was the crossing of the eight surface-car loops. These were crossed separately, each of them requiring from one to three months, during which time traffic was transferred from the loop in question to the other loops.

The work was done under the direction of the Department of Bridges, of which Alexander Johnson is chief engineer and Calvin Crocker, engineer in charge. The work was executed by the North Eastern Construction Company.

CHICAGO SPENT FOR HEALTH IN 1914 34 cents per capita. New York in 1910 spent 67 cents, Boston 72 cents, Pittsburgh 42 cents and Washington 50 cents. On this showing Dr. George B. Young, commissioner of the Health Department in Chicago, is making an appeal to the budget makers to raise his yearly appropriation from $1,050,000 to $1,350,000. Prof. E. O. Jordan at a recent conference stated the benefits of preventive medicine in terms of typhoid victims. At the rate prevailing twenty years ago Chicago would have in the next twenty years 150,000 typhoid cases. At this year's rate there will be only 25,000 cases. He urged that appropriations be made to continue this work.

Bituminous Macadam by the Cold-Mixing Method

Abstract of Paper Read at Fourth American Road Congress by Irving W. Patterson, Chief Engineer of the Rhode Island State Board of Public Roads

SINCE 1906 the Rhode Island State Board of Public Roads has constructed a large amount of bituminous macadam by the cold-mixing method. The results were described at the Fourth American Road Congress, held in Atlanta, Ga., Nov. 9-14, 1914, by Irving W. Patterson, chief engineer of the State Board of Public Roads. His paper contained much tabular and descriptive data, some of which have been rearranged for publication in the following article.

For the standard 14-ft. road, crushed stone which passed a 3-in. screen and was retained on a 1½-in. screen was first spread over the well-rolled subgrade to a depth of 4 in. after compression. This course was not filled with sand or stone screenings but was well rolled. Crude tar was very lightly sprinkled over this first course. Crushed stone of the same sizes was then mixed with crude tar in the proportion of 15 gal. of tar per cubic yard of stone. Mixing was carried out on a portable wooden mixing platform near the point where the mixture was being spread. The mixture of stone and tar was spread over the first course of crushed stone to a depth of 2 in. after compressions, and was well rolled, after which a covering of stone screenings was applied. The results secured on this first experimental section of bituminous macadam were remarkably successful, largely due to the stable, gravelly subsoil. No repairs have been required to date. The surface is intact and presents a perfect mosaic appearance, the top surfaces of the stones in the mixture being all in evidence.

SEAL COATING

Subsequent experiments have proved the advisability of seal-coating. We attribute the marked success of the early work in spite of the absence of a seal-coat largely to the character of the travel. The horse-drawn traffic is very light, and we believe that the blows of horses' shoes on the exposed surfaces of the soft stones would be destructive were it greater.

In 1908 the cold-mixing method was taken up to much greater extent. Various experiments in both materials and methods were carried out, and to-day we are able to see that these experiments were largely negative in results. Perhaps the greatest failures in the work were on sections where tar products and asphalt products heated in separate kettles were used in combination as a binder for the top course of crushed stone. Where this combination of binders was employed raveling started the following year and increased very rapidly. In 1913 a heavy seal-coat of asphalt was applied to several of the roads bound with a combination of tar and asphalt and the results secured from this treatment appear highly satisfactory.

PRECAUTIONS NEEDED

It has been proved in our work that the utmost care in using the cold-mixing method is necessary. The crushed stone must be perfectly dry at the time of mixing and all stones must be perfectly covered with bitumen in order that good results may be secured. The matter of carrying out the rolling is also important in its effect on the results obtained. It is, of course, necessary to secure by rolling as compact a mass as possible, but we have found that considerable care must be exercised in regulating the time and amount of rolling. If the weather is cool at the time of construction, we frequently postpone the heavy rolling until midday, when the maximum warmth is experienced, although the initial rolling is done as soon after the mixture is laid as possible.

CHARACTER AND SIZE OF STONE

The character and sizes of the crushed stone employed are also of great importance. We have secured the best results, as far as stone is concerned, with our native rock, which is rather variable in character. As a rule our native rock is softer than trap rock and breaks with a much more irregular fracture. There is more or less breaking by rolling, and this appears to be beneficial rather than otherwise in that a denser pavement is secured. We feel that if trap rock were employed smaller sizes would be necessary than with a softer stone, unless there is a certainty of securing a perfect crusher-run from 1½ in. to ¼ in. or less.

We have experimented with heating the aggregate previous to mixing, but the experiments seem to show inferior results. The aggregate in bituminous macadam contains at best a large percentage of voids, and in the heated aggregate there was noted a tendency on the part of the binder to run off from the stones, leaving only a very thin coating on each stone. In several cases, for instance, 18 gal. of binder per cubic yard of stone were necessary to cover all stones in our unheated mineral aggregate, but when the aggregate was heated, 12 gal. sufficed and there would be considerable bitumen which would run through the mineral aggregate and be lost. The tendency for the bitumen to cover a heated aggregate very lightly seems to be due to the fact that the heat retained by the stones delays the settling of the binder, with the result that it continues to run for some time. We recognize that it is necessary to heat the aggregate in a dense mixture such as a bituminous concrete pavement affords, but in bituminous macadam work by the mixing method we prefer a cold aggregate or an aggregate heated but slightly.

WEATHER CONDITIONS

Weather conditions influence the results considerably. Roads built late in the fall, just before freezing sets in, are not likely to be as satisfactory as those built in midsummer, even though the temperature at the time of construction is not low. It seems to be a decided advantage to roads built by this method of construction to have a comparatively long period of warm weather immediately after construction in order that the surface may become freed from the top covering of stone screenings and well smoothed out before snow and ice appear. In Rhode Island we consider the season most favorable to this type of construction to be between the middle of May and the middle of October.

On the whole the cold-mixing method of constructing bituminous macadam as practised in Rhode Island appears to be an economical pavement for motor-vehicle traffic. It does not appear to the writer as suitable for heavy horse-drawn traffic or for a heavy mixed traffic. The travel on several of the trunk lines in Rhode Island consists of motor vehicles to the extent of more than 90 per cent, and it is on these roads that we expect in the future to confine our bituminous macadam roads built by the cold-mixing method. Through large villages where the percentage of horse-drawn traffic is large we expect to take up a stronger method of construction.

Causeway at New Philadelphia, Ohio

Steel Bridge Washed Out by 1913 Flood Has Been Replaced by Reinforced-Concrete Beam-and-Slab Structure

By EDWARD STINGEL
County Engineer, Tuscarawas County, Ohio

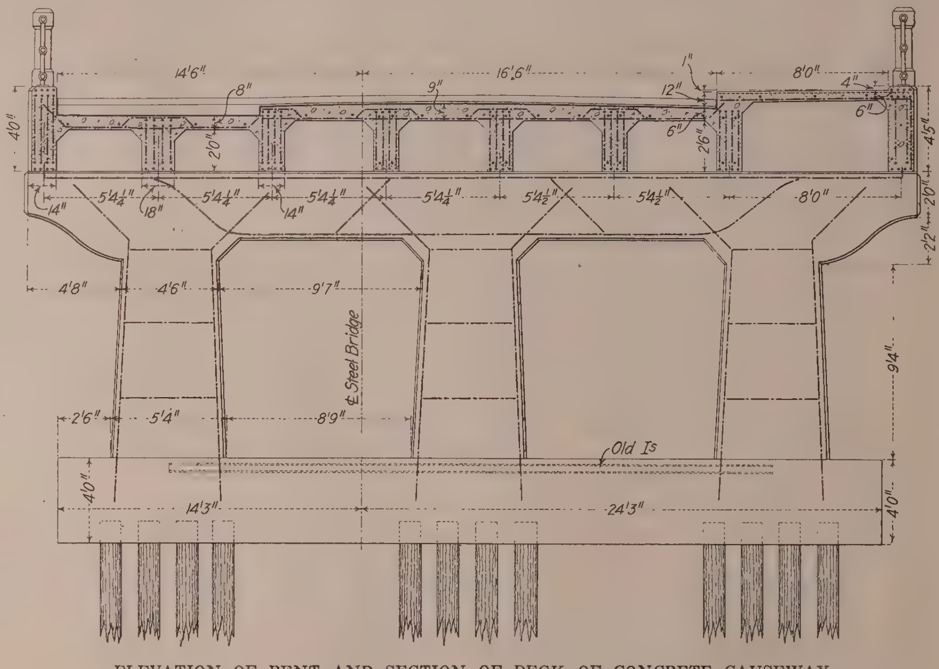
NEW PHILADELPHIA, Ohio, is located in the Tuscarawas valley, 40 mi. north of the confluence of the Tuscarawas and Muskingum Rivers. The Tuscarawas River, which has an average width of 360 ft. in Tuscarawas County, passes through the city with a flood-plane width of 900 ft. Prior to the unprecedented flood of March, 1913, the river was spanned with a wrought-iron bridge, and South Broadway was carried across the flood plane on an embankment at an elevation of 3 ft. below the high-water line. Needless to say, the disastrous flood referred to not only destroyed this embankment but also completely wrecked the bridge. In working out a plan for the reconstruction of the street it was decided to span a part of the flood plane with a causeway of sufficient waterway to provide for a like flood without increasing the erosion that might be effected at other points in the vicinity.

The tentative waterway section was submitted to the Ohio Valley Flood Commission, Cincinnati, for an opinion as to its sufficiency. The commission consented to make an investigation through Major L. H. Rand and Capt. W. W. Mitchell, Corps of Engineers, U. S. A. After making an inspection of the site, the tentative plan was approved.

From the accompanying illustration a general idea may be had of the plan of construction. The causeway consists of sixteen 28-ft. reinforced-concrete beam spans, supported by concrete abutments and reinforced-concrete skeleton piers. The beams are built continuously, except that the superstructure is separated into three units. The two contraction joints in the superstructure were filled with Cary expansion felt and covered with a T-iron section. Construction joints were made only at points of minimum shear. The roadway has a clear width of 31 ft. and in addition there is an 8-ft. walk.

The assumed conditions for making the computations are as follows: Concrete in compression, 625 lb. per square inch; steel in tension, 14,000 lb. per square inch; concrete in shear, 65 lb. per square inch. Bending moment of continuous beams was computed on the basis of 4/5 that of a simple beam. No allowance was made for T action in the beams. The assumed live load on the roadway beams and the slab was a 20-ton roller on a surface of 12 x 20 ft. The assumed live load on the street railway beams is a 40-ton interurban electric car.

The aggregate is a local glacial deposit of river-washed and gravel, screened and accurately measured in the proportion of one part Portland cement, two parts sand and four parts gravel. Universal cement was used in the major part of the work.



ELEVATION OF BENT AND SECTION OF DECK OF CONCRETE CAUSEWAY

CONSTRUCTION

The footings were carried down 15 in. below the ground water line; twelve piles 30 ft. long were driven into each pier pit. The average penetration on the last seven blows with a hammer weight of 2700 lb. and a drop of 30 ft. was 10 in. The rebound was reduced to a minimum by keeping the hammer block in good condition. This gives a sustaining capacity, with a factor of six, using Wellington's formula, of 32 tons per pile. The actual total load per pile is 28 tons. Hence there is a sustaining capacity on the safe side of the assumed conditions and no settlement has occurred.

The forms for the piers were built up in sections and bolted together, which admitted easy removal. These forms were re-used many times.

The roadway beams are reinforced with

six 1⅛-in. round corrugated bars of medium steel. The street railway beams are reinforced with eight bars of the same size. Each end beam is reinforced with one additional bar of the same size. In addition to the usual bar reinforcement in the sidewalk one layer of No. 16-3 expanded metal was placed 2 in. below the surface. The roadway slab is reinforced with ⅝-in. bars, each alternate bar being bent over the beams. Longitudinal and shear reinforcement was made with ½-in. bars.

The superstructure is built independently of the substructure. The roadway surface is waterproofed with alternate layers of tar and felt built up to the thickness of four layers.

SPECIAL FEATURES

The architectural lines of the structure are quite effective. The panels, 3½ in. deep, extend in unbroken lines from pier to pier. The corners of the panels are relieved with quarter-round molding.

NEW PHILADELPHIA CAUSEWAY WITH MAIN STEEL SPANS IN BACKGROUND

The handrail is of a combination pipe and concrete post construction. The top line is a 2½-in. gas pipe, and the other two are 2-in. pipe. Directly over each pier a pilaster 2 in. thick is built, which finishes into the railing post. The falsework was supported with 4 x 4-in. timbers spaced 4 ft. on centers directly under each beam.

Provisions for electric light and telephone poles were made by extending the cantilever on two of the piers an additional 12 in. to carry iron poles. Thus none of the roadway is obstructed.

The total cost of the structure was $32,000, based on the following unit prices: Concrete, unclassified, $8.70 per cubic yard; excavation, unclassified, 90 cents per cubic yard; steel bars, $65 per ton; waterproofing, 45 cents per square yard; handrail, 75 cents per linear foot.

The causeway was built by MacWardell, of Strasburg, Ohio, Fred Heister being the foreman on the work. All engineering work, both the preparation of plans and field supervision, was done by the office of county engineer.

AREAS COMPRISING 69,058 sq. mi. were covered last year by geologic surveys of various degrees of refinement, ranging from detailed surveys to broad reconnoissance work. The work was done by the U. S. Geological Survey, from which this information was received.

A Privately Financed System of Sewers

Unusual Legal and Financial Problems Were Involved in a Project for the Borough of Troy, Pennsylvania

By HENRY W. TAYLOR
Consulting Engineer, Albany, N. Y.

THERE have been only a few instances in the United States where sewerage systems have been installed by private individuals for the benefit of a municipality. Such a scheme is generally worked out to respond to unique local conditions, but the few instances of such development are of interest in that they involve unusual legal and financial problems.

In Troy, Pa., a committee of citizens has undertaken the installation of a sewerage system by private capital. The borough has a population of about 1300 people and there are over sixty privately owned, domestic and industrial sewers now discharging into Sugar Creek, which runs through the developed area of the corporation. The summer flows of the creek are low and nuisances have resulted from these domestic and industrial wastes. These conditions seriously affect the physical and sanitary condition of the conspicuous areas of the borough. Furthermore, the State Department of Health has threatened action against the owners of these sewers looking toward the abatement of nuisances on the Sugar Creek watershed. However, the limit of bonded indebtedness of the borough will not permit of the immediate installation of a municipal sewerage system.

In 1913 a reconnoissance survey and a sketch plan were made of a tentative layout for a proposed sewerage system and these tentative plans were approved by the State Department of Health. The approval of this preliminary layout determined the degree of purification to be required and fixed, within reasonable limits, the cost of such a system. Detailed plans have since been prepared, including a complete sewer system, together with treatment in Imhoff tanks, the effluent of which is dosed with hypochlorite.

LEGAL ASPECTS

The legal aspects of the situation have been formulated in detail and are the chief items of interest. Having obtained a preliminary approval of the State Department of Health, the investor was given a definite guarantee as to the extent of treatment and the maximum amount of capital which would be required for the system. A preliminary canvass indicated the willingness of a large number of people in the borough to subscribe money for such a sewerage system, under proposed contracts. These documents consisted of an ordinance and three contracts. The ordinance authorized the borough council to enter into contract with the trustee of funds to rent from the subscribers a sewerage system, paying therefor a sum equal to 5 per cent of the money invested. The first contract is a contract between the borough and the trustee of the subscribers in which the terms of rental are stated in detail. The second contract is the contract between the trustee of funds and the subscribers of same. The third contract is a lease signed by private property owners, renting sewerage privileges from the borough.

FOUR PARTIES INVOLVED

These documents were carefully prepared and are of particular interest and their main features warrant mention. There are four distinct parties to the scheme:—the subscriber, the trustee of funds, the borough, and the private property owner who pays an annual rental to the borough for the use of the sewer system. There is also a sewer construction committee of three, the trustee of funds, a member selected by the subscribers, and one member selected by the borough council. This committee will supervise the construction of the sewerage system acting as advisers to the trustee, who consults the committee on points of major importance.

The subscribers vest all rights to funds and to the plant, when installed, in the trustee, and the borough contracts to rent the entire system from the trustee and pay him a rental therefor of 5 per cent per annum on the amount invested in the system by the subscribers. The borough agrees to maintain the system and will rent sewer privileges to individuals in the borough and collect from them the rentals for all connections to the system. Before the borough signed this contract with the trustee it required that a list of subscribers and a list of lessees of the system be submitted to it, the amount subscribed being sufficient to install such part of the system as will now be built and the total rentals from lessees representing 7½ per cent on the capital to be invested. This extra 2½ per cent, over and above the 5 per cent paid by the borough to the trustee, was included as a safety factor and to allow for cost of maintenance, repairs, over-head charges, etc.; these costs must be paid by the borough.

RENTALS

Rentals received by the borough are to be used for no other purpose than the payment to the trustee of interest on capital invested, or in connection with the maintenance of the system or the purchasing of interest of investors. The borough has the right to purchase the plant at cost and can purchase subscribers' interests as offered for sale or can force the sale of a private interest chosen by lot.

The borough thus gradually acquires the ownership of interests, reducing the interest or rental charges payable to the trustee, and when the final payment for all interests is made, the borough is complete owner of a municipal sewerage system. It is stipulated that, with the agreement of all parties to the various contracts, the various contracts, agreements, etc., can be changed and the trustee can be abolished so that, as complete owner of all interests, the borough can do away with all former organization and assume the system as sole owner with complete rights, control, management, etc., of the system.

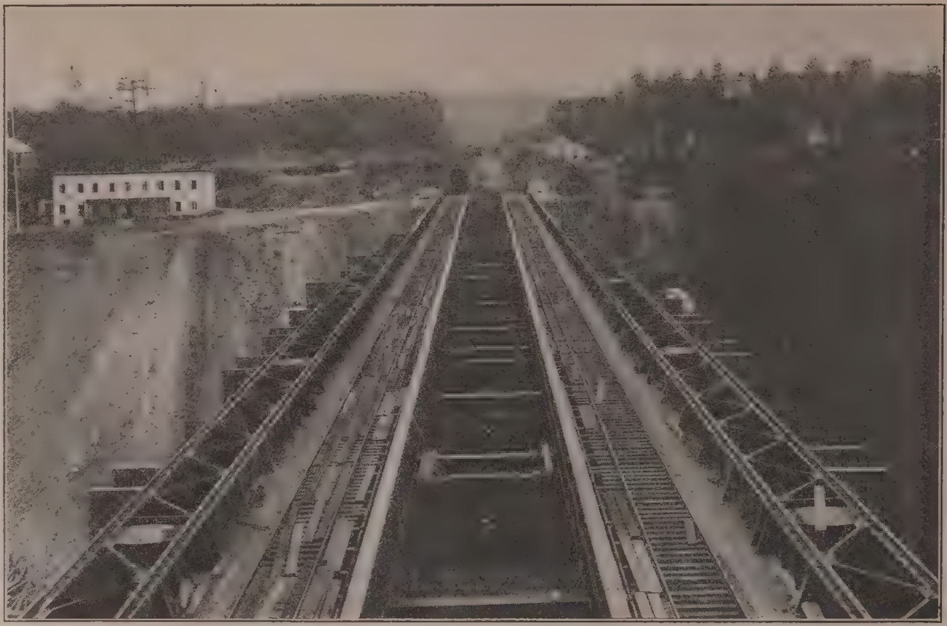
TRUSTEE'S DUTIES

The trustee is to keep accurate accounts of books for the determination of the total cost of the system. The title to property is vested in the trustee, while, by a majority vote of the interests in the system, the trustee may be abolished. The trustee is committed to building all laterals that the committee may deem expedient, and this expediency is based on the securing of sufficient leases from private individuals to equal 7½ per cent on the money invested in the lateral sewer. There is also granted the trustee the right to solicit additional subscriptions for additional work, provided rental contracts guarantee 7½ per cent of the capital invested. He may also loan money at a rate of not over 5 per cent on the same basis.

In their effect the documents first secured pledges from individuals and guaranteed sufficient capital for the project. On the other hand, the borough assumes the responsibility of paying interest on this capital, but the borough is assured, by contract leases, of an adequate income to meet this interest charge from the letting out of sewer privileges to individual property owners.

NO TAX ON THOSE NOT BENEFITED

It is to be noted that the scheme involves no present tax on any property owner who does not actually connect to the system. Purchase of the several interests of the private investors will be made by the borough from funds voted by the tax-payers for this purpose, so that, eventually, the original cost of the system will be distributed among all property holders. Until purchased by the borough the burden of cost of the improvement is borne entirely by the users of the system.



FLOOR SYSTEM ERECTED ON INSIDE OF FALSEWORK—TRACKS FOR TRAVELER

Erection of New Quebec Bridge

North Anchor Arm Has Been Completely Placed by 1000-Ton Traveler since August 1, 1914, with Exception of Two Upper Panels

By H. P. BORDEN
Assistant to Chief Engineer, Board of Engineers, Quebec Bridge

CONSIDERABLE progress has been made toward the erection of the new Quebec Bridge. During the summer of 1913 the approach spans on the north shore from the abutment to the anchor pier were fully erected. They were erected by derrick cars on heavy wooden and steel falsework. As these spans would have to carry the 1000-ton erection traveler, and as the concentrated wheel loads from this traveler were considerably greater than the live loads for which the spans were designed this falsework was made sufficiently strong to take care of these reactions.

The traveler was erected during the winter of 1914 on the shore just north of the abutment and was ready to move out early in May. This traveler was carried on two two-rail tracks spaced 54 ft. center to center. The two inner rails were carried on the top flanges of the outside bridge track girders, the outer rails being carried on special erection girders resting on the falsework and thoroughly braced to the track girders themselves. The traveler was moved out over the approach spans to the anchor pier on May 18 and proceeded to erect the inside falsework carrying the floor of the anchor arm on which the traveler runs.

The main floorbeams of this floor were carried on special erection girders supported by this falsework and were located in approximately their correct positions. The main track girders, sub-floorbeams and stringers were then erected in place and special girders erected outside the track stringers for the erection traveler.

LOCATING THE SHOES

When this falsework had been completed out to the north main pier the main shoes were erected, the bases for these shoes were accurately placed and the entire shoe was erected. An elaborate series of triangulations and measurements, extending over several months, were made to locate the longitudinal and transverse center lines of these shoes. Once the bases had been placed in their proper position the rest of the shoe went forward rapidly, and a start on the erection of the bottom chords was made.

According to the program of erection it was proposed to lay the bottom chords complete with their lateral bracing from the main shoe to the anchor pier, the main traveler moving back as the work progressed. When this had been done the traveler moved ahead again to the main pier and started the erection of the web members up to their middle intersection above the floor. This was carried back to the north anchor pier,

ERECTING IN YARD PANEL OF TOP-CHORD EYEBARS IN SUPPORTING TRUSSES after which the erection of the upper half of the web members in the top chord was effected, the traveler moving forward as the work progressed.

Work stopped for the season with the anchor arm completely erected with the exception of two upper panels near the main pier.

DEFORMATION CAMBER

Owing to the deformation of all members under full load, it has been necessary to manufacture the compression members slightly longer and the tension members slightly shorter than their actual geometric length. On this account there would naturally be difficulties in making the pin connections between the various members of the anchor arm, in view of the fact that all these members are erected on falsework and consequently under no load except from their own weight. To offset this difficulty, the bottom chord was given a camber which would correspond to the deformations indicated by the Williot's or deformation diagram. In other words, after the bottom chord had been entirely riveted up from end to end, it was lowered a certain amount at each panel point by means of jacks at the foot of the steel falsework to correspond to this deformation. The final displacement, including deformation of falsework posts, amounted to zero at the main shoe, 7 in. at the middle point and 5 in. at the north anchor pier, varying practically uniformly between these points. Owing to the length of this bottom chord it was possible to obtain this deformation without any difficulty.

To offset the effect of deformation of the web members from their own weight, and to allow pins to be driven without any difficulty, elongated holes were bored in the upper end of the upper tension diagonals and in all of the eyebars in the top chord. The holes in the diagonals were elongated 2 in. and in each eyebar ½ in. at each end, the elongation being made in the side of the hole nearest the center of the member. By this means it was possible to drive these pins without any difficulty, the play in the holes being taken up as the cantilever arm was erected and stresses applied to the members of the anchor arm.

DRIVING THE PINS

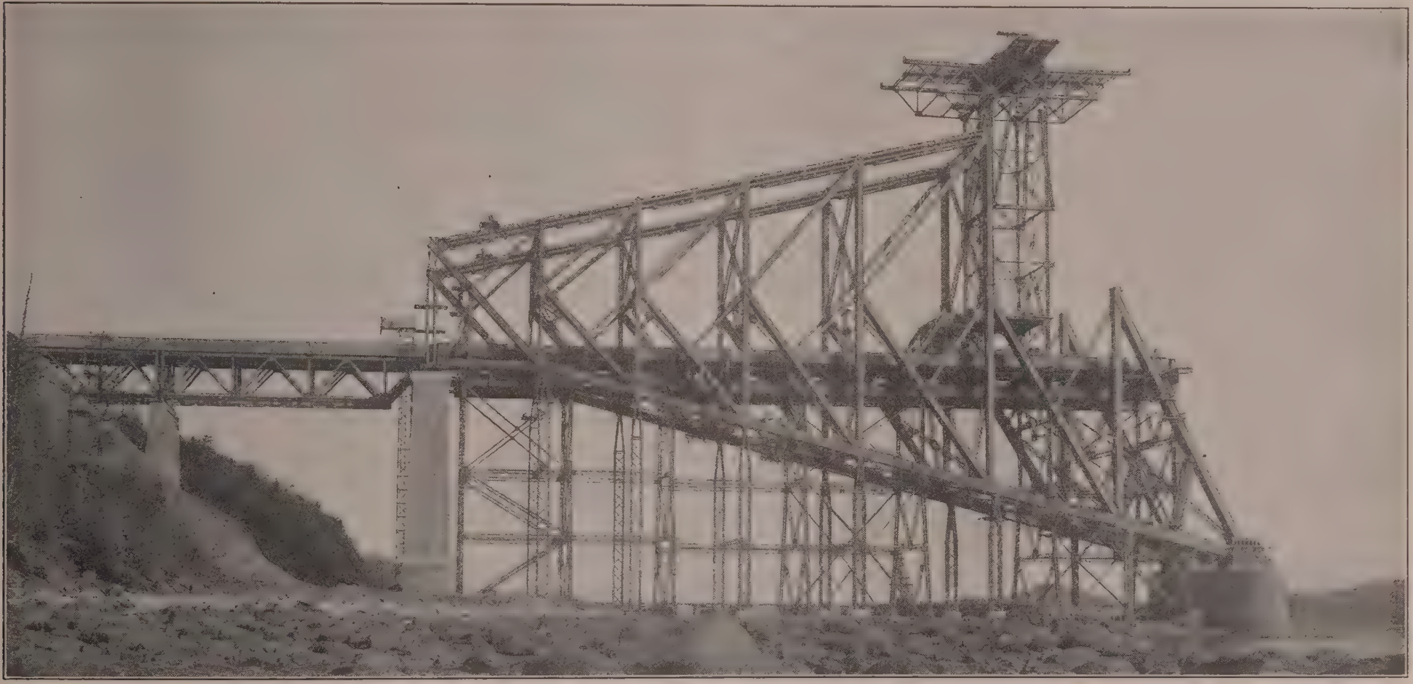
The driving of pins was materially facilitated by the fact that these pins are in duplicate, each pin going through two webs only of the four-web members. This also applies to the top chords. In designing the driving rams for these pins it was estimated that heavy rams, weighing in the neighborhood of two or three tons, would be required. It was found in actual practice, however, that these were not necessary, and after the first one or two pins had been driven a section of 80-lb. steel rail 10 ft. long was used and pins were in practically every case driven home in from one to two minutes.

The maximum clearance allowed in all pin holes is 1/32 in. + 1/100 in.

The amount of steel erected during the season just passed is about 15,000 tons, and this was practically erected in four months, from Aug. 1 to Dec. 1.

A duplicate traveler is now being erected on the south side of the river and will be in commission the first thing in the spring. If the work is carried on according to program it is expected that the remainder of the anchor arm and the whole of the north cantilever arm, as well as the south anchor arm, will be erected next season.

The St. Lawrence Bridge Company, of Montreal, is the contractor for the superstructure. The work is being carried out under the supervision of the Board of Engineers, Quebec Bridge, consisting of C. N. Monsarrat, Ralph Modjeski and C. C. Schneider. Mr. Monsarrat is chairman and chief engineer of the board.



NORTH ANCHOR ARM WHEN WORK CLOSED DOWN FOR THE SEASON—TWO INDEPENDENT SYSTEMS OF FALSEWORK

TYPHOID DEATH RATES IN CHICAGO during 1914 were the lowest in its history. The rate per 100,000 population was 7.56 in 1914—28 per cent less than for 1913 and 48.7 per cent less than the average yearly rate for the previous ten years. The total death rate was 14.17 per 1000 population, 6.2 per cent less than the previous year and 3.6 less than the previous decade.

Reinforced Concrete for Railway Water Tanks

Advantages over Wood or Steel Include Low Cost of Maintenance, Freedom from Leakage and Chance to Place below Ground

By J. T. BOWSER

Maintenance of Way Department, Queen & Crescent Route, Danville, Ky.

FROM the beginning of railway operation until the economical manufacture of steel tanks became possible, the wooden tub was used almost exclusively for railroad water tanks. The steel tank has to some extent supplanted that of wood and now that concrete has advanced beyond the experimental stage its use is growing in favor where the permanency of the location is assured.

To offset the increased first cost of the concrete tank, the advocates of this character of construction find many advantages. First, there is the practically negligible cost of maintenance. A concrete tank, under normal conditions, may be said to be indestructible. There are no repairs, no painting, no depreciation. Loss by leakage fifteen or twenty years after construction is no greater than when first filled, while with the wooden tank leakage is no inconsiderable item in the last few years of its life.

If by accident or through necessity the concrete tank becomes dry, there is no damage from shrinkage and no loss of water on this account.

In locations where natural elevation is not economically available, the concrete tank may be readily constructed on steel posts, concrete-incased steel or reinforced-concrete pedestals, either of the latter being preferable, as they will be not only more easily maintained, but will also be more in keeping with the balance of the structure. In locations where a satisfactory natural elevation is available, the concrete tank may be placed on an annular concrete foundation, or, as has been done where the near-surface material supplies the proper foundation, it may be placed directly on the surface.

Another plan of construction, which is probably the most satisfactory, particularly where a large storage is desired, is to locate the tank partly or wholly in excavation. In such cases the trouble from ice is reduced to a minimum, the concrete yardage and reinforcement are reduced, the structure, in no case a thing of beauty, is placed out of sight, and the capacity may be much larger without a disproportionate increase in the concrete yardage.

In general, there appears to be a tendency, in constructing railway water-service tanks, to elevate them much more than is necessary to give the proper flow from the water columns. Every unnecessary foot of head increases fuel costs, wear on pumps and machinery and damage to pipe lines and columns through water hammer. Therefore, at points where the tank must be located on an elevation, the concrete tank has an added advantage in that it may be placed near or on the ground.

State Highway Displays Scenic Splendors of Washington

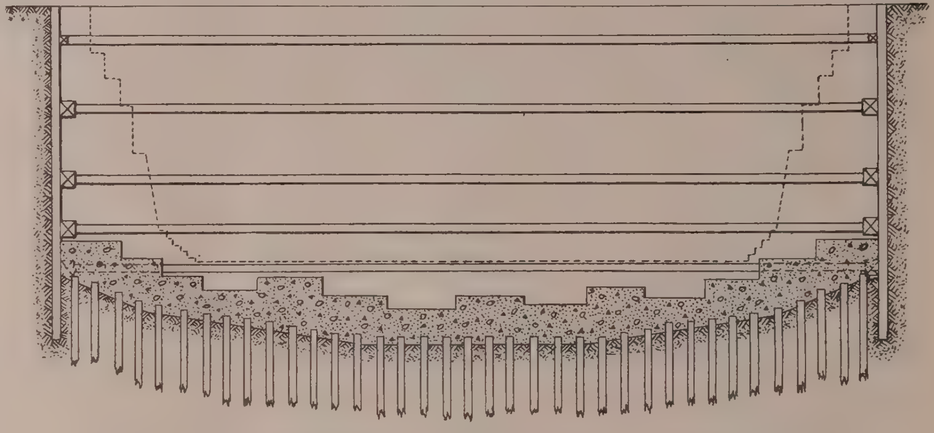
SELDOM does a highway exhibit the scenic grandeur of a State in so impressive a manner as the Olympic State highway through the timberlands of Washington. One of the scenes along this picturesque road—a cleft through the dense forests of the Pacific Northwest—is shown in the accompanying photograph which is used as the front cover of this week's issue. The highway starts at the State capital and, when completed, will encircle the Olympic Peninsula in a 250-mi. loop. It is a gravel road and the surfacing was obtained along the route. Immense ferns flank the roadway on either side and an idea of their height is suggested by the members of the automobile party, whose heads barely reach above the dense growths at the left of the picture.

THROUGH THE "GIANTS" OF THE NORTHWEST

New Plan for Building Pearl Harbor Drydock Near Honolulu

Large Naval Structure on Which the Cofferdam Method Was Found Unsafe Will Be Constructed in Full-Width Sections 60 Feet Long

ON Nov. 25, 1914, the U. S. Navy Department signed a supplemental agreement which provides for a new design of the Pearl Harbor drydock. For twenty-one months before this, investigations had been going on to determine a safe, permanent and not too costly method of constructing the dock at this site. The following information about the new design and the method of construction are taken in large part from the supplement to the "Confidential Bulletin" published under the direction of the Bureau of Yards and Docks and the Corps of Civil Engineers, U. S. N. The supplement is devoted entirely to a description of the work, written by Civil Engineer E. R. Gayler, U. S. N.



SECTION OF FIRST COFFERDAM, SHOWING CONDITION AT TIME OF COLLAPSE

EARLY OPERATIONS

The site of the drydock is on Pearl Harbor Bay, Island of Oahu, H. T., about ten miles from Honolulu. The dock as originally planned was to have been 1100 ft. long, divisible into two sections by means of a central gate. The contract finally awarded to the San Francisco Bridge Company in 1909, however, called for a dock 600 ft. long. In the following year both the width and length of the structure were increased, the latter to 800 ft. The design was for a concrete structure having a heavy floor intended to act as an inverted arch. After full investigation at the site, it was decided to found the structure on piles, which actually averaged 20 ft. of penetration.

All of the Hawaiian Islands are volcanic, and the site selected for the dock was on a 15 to 20 ft. ledge of lava, about 15 ft. above tide level. Below this lava, which was an external flow, were layers of lava mud, coral and broken rock.

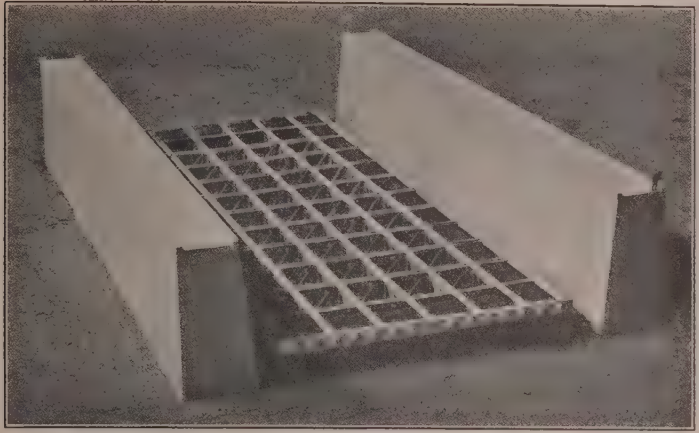
The contractors undertook to construct the work in four sections. Heavy timber cribs were built for each section, and 12-in. sheet piling driven around them. The space behind the sheet piling at the sides of the dock was backfilled. In the attempt to unwater the first section, the water level was lowered 17 ft., when the cribbing, especially at the center, started to rise. It was then decided to drive the piles and place 8 ft. of concrete under water in this section, which was done. The second attempt at unwatering exposed the concrete, which was found unsatisfactory. Leaks rapidly developed beyond the capacity of all available pumps, and the section was again flooded. It was decided to increase the length of the dock to 1000 ft. and to enrich the mixture of concrete, and an additional appropriation was secured on that basis.

COLLAPSE OF COFFERDAM

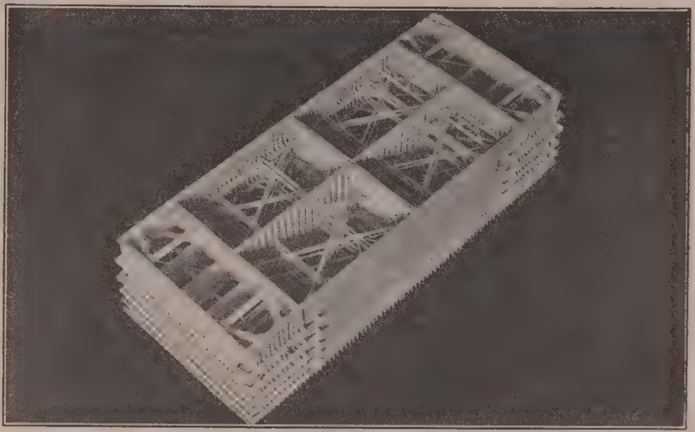
The contractors then started work on the second section, and on the removal of the poor concrete in the first. The second section was the first ready for unwatering, and pumping was begun early in February, 1913. The water had been lowered 30 ft. when it was noticed that the section was slowly rising. The movement becoming more rapid, pumping was stopped and an attempt made to flood the section. Before this could be done, however, the entire section rose several feet and collapsed. A cross-section of this cofferdam is shown herewith. Steps were taken to clear away the wreckage, and an examination was made by H. R. Stanford, chief of the Bureau of Yards and Docks, and F. R. Harris, both of the Corps of Civil Engineers, U. S. N. They reported the failure to be due to the fact that the weight of concrete in the bottom and the anchorage effect of the piles were not sufficient to overcome the uplift from hydrostatic pressure. They further reported that the dock could be built by the method being followed, but that to do so would entail placing more concrete under water, and possibly also loading down the sections with removable ballast.

PROPOSED PLANS

Mr. Harris advised abandoning this plan, however, because of its risks. He suggested dividing the dock into 100-ft. sections, to be constructed as caissons, launched, aligned in place, and sunk on a prepared pile foundation by building up their concrete masonry. It was also suggested at the time by Mr. Gayler that the work might be done by casting large blocks on shore, placing them with the 150-ton floating crane which was at the site, and concreting between them with a tremie. It was later reported, however, that while the existing site was suitable for a dry dock, it would be liable to unequal settlement which might crack or otherwise damage a non-rigid structure. This opinion was based on extensive borings



CONCRETE AND STEEL BASE COMPLETE ON FLOATING DOCK



STEEL COFFERDAM—BALLAST-TANK STRUCTURE, TOP VIEW

and large scale test loads made by Civil Engineers E. R. Gayler, F. R. Harris and S. Gordon, who had been appointed on May 5, 1913, to investigate the site.

PLANS BY ALFRED NOBLE

In Aug. 1913, the department requested the late Alfred Noble to examine the site and recommend procedure for completing the drydock. Mr. Noble was one of the most distinguished of American engineers, and his unmatched experience and professional knowledge gave his opinions the most compelling value. After spending 12 days directing additional tests at the site, Mr. Noble reported on Oct. 20 to the department. He proposed two designs, the first of which was to sink in place reinforced concrete caisson sections, which should be the full depth of the floor, and from the base for the side walls. The bottom of each caisson would be solid, and it would be divided by its reinforced concrete cross-walls into pockets about 14 ft. square, open at the top. The caissons were to be surmounted at each end by a cofferdam enclosing the side wall section, and launched from a floating dock. They were to be sunk by filling with water, and the pockets in the floor were to be concreted under water. The end cofferdam could then be pumped out and the walls built. Bottom closures were to be made between sections with a tremie. Closures in the side walls were to be built behind bulkheads after the dock was pumped out.

The second scheme proposed by Mr. Noble was similar, except that the sections were to be sunk after towing them to place by depositing concrete on them. This did away with the placing of concrete under water, except in closing the floor joints, and required less reinforcing and cofferdam work.

In March, 1914, Civil Engineer L. N. Cox, U.S.N., added to this plan the idea of regulating the sinking of the sections by means of a steel ballast tank built between the end cofferdams. The sectional design as applied to drydocks is, perhaps, new. Sinking such structures as caissons, however, has been accomplished before, both at Toulon and Dunkirk. At Toulon, the whole dock, and at Dunkirk a large addition to a dock, were sunk in one operation. It is the chief advantage of the sectional plan that it avoids the expense of such large floating structures.

PLAN ADOPTED

After the death of Mr. Noble, these plans were combined and developed by H. R. Stanford, and the following program, which is now to be proceeded with, adopted:

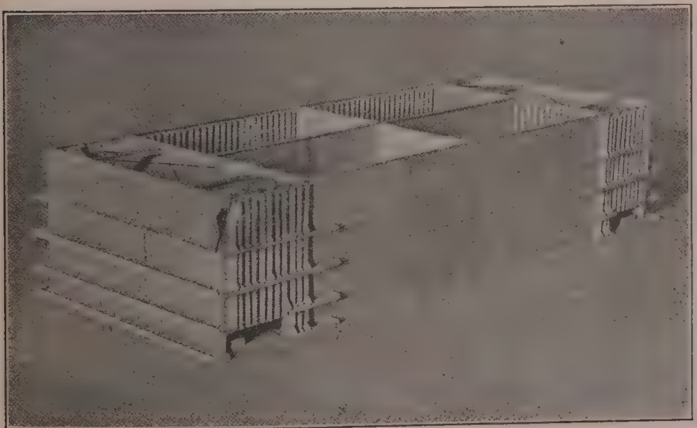
The subfoundation is to consist of piles, cut off to grade under water and backfilled with a layer of broken stone 1 ft. thick and level with the cut-off. On this, full-width sections of the dock 60 ft. long will be sunk. These sections will be built successively in a floating dock, from which they will be launched. First, a structural steel frame, with trusses crossways of the dock and bracing lengthways, will be set up in the launching dock. This base is shown in one of the illustrations. The concrete of the base will then be poured to full height around all four sides of the section, and to a height of 8 ft. in the middle portion. The steel in the section at this time will weigh 150 tons and the concrete 7600 tons. Owing to partial submergence, however, the floating dock will only have to sustain a load of 5000 tons.

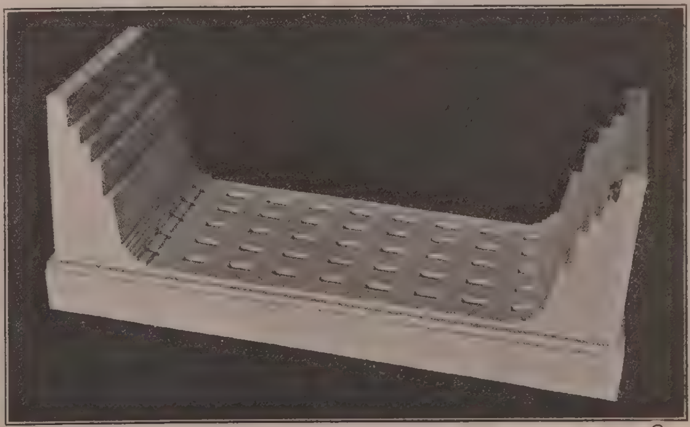
Next, water will be admitted to the floating dock, submerging it till the ballast-tank-cofferdam structure can be floated over the base. This structure, which is of steel, is shown in the above miniature view. Its main features consist of the central ballast tank, 60 x 108 ft. in plan, and the two end cofferdams in which to construct the side-wall sections of the dock.

When this is in place, water will be removed from the floating dock, and as it rises, the cofferdam will be guided into place on top of the base by tapering steel guides. A lead gasket, placed around the top of the base before sinking, makes the joint between base and cofferdam watertight. The raising continues till this joint comes in sight, when the cofferdam is secured to the base by long holding-down rods which extend clear to the top of the steel dam. This cofferdam, of which only one will be built, is 45 ft. high, weighs 875 tons, and will cost about $90,000.

PLACING OF THE SECTIONS

When the bolts have been tightened, the construction dock is sunk until the section floats clear of it. This occurs when the base draws about 28 ft. of water. The section is then adjusted in place and sunk by filling the ballast tank. If any error is made in the first alignment, the section can be readily raised and re-aligned. The cofferdams at each end and the space beneath the ballast tank are then unwatered, and the bottom and side walls completed in the dry to a point 1 ft. above high tide. It is necessary, however, to support the weight of the ballast tank, which remains full during this operation. This is accomplished by forty-five steel pedestals which rest on the transverse trusses of the steel framework in the base. Pits for these pedestals are, of course, formed out of the floor





LEFT, END GATES IN DAM OPEN, TOPS OF DOCK WALLS SHOWING IN GATES—RIGHT, FINISHED SECTION OF DOCK concrete which is placed after sinking.

The next step is to take off the top nuts of the long holding-down rods, which releases the cofferdam structure from the completed section. Unwatering the ballast tank then floats the cofferdam. Near the bottom in one end of each of the end-cofferdam sections are doors, which can be opened when this steel structure has been floated, allowing it to be towed clear of the side walls. In the meantime, another base-frame is erected and concreted in the construction dock, and is ready to receive the steel structure on its release.

This method, however, will not answer for constructing the head of the dock, which is semi-circular in shape. It was decided to cast this section in blocks on shore, which will be placed by the floating crane. These blocks will be 38 ft. high, 5 to 8 ft. wide along the circumference of the semicircle, and the full thickness of the wall. They will weigh 150 tons each. These blocks will be set about 6 ft. apart, and the spaces between them unwatered by the cofferdam method. The joints can then be filled in the dry. The blocks will also have openings through them so that in pouring the joints the whole semicircle will be bonded together.

The pump well is to be a separate structure, 45 x 95 ft. in plan, built as a floating structure, and sunk into place adjacent to the outer end of the dock.

The time for the completion of the work is three years from the date of signing the contract. The entire cost of the work, including that under the first and the supplementary contracts, will be $4,485,000.

Summer Municipal Wastes

Chicago Street Department Makes Analyses of Sixty Loads of Refuse from the Seven Zones into Which City Is Divided

INORGANIC household wastes, removed to dumps by the Chicago Bureau of Streets, were analyzed from June 17 to Sept. 16 by selecting 60 representative loads from seven different zones into which the city was divided. The groups are based on similar existing conditions. Results of the analyses are given in a recent report by W. J. Galligan, assistant superintendent of streets, from which these notes are taken.

The segregation of the wards into the seven groups was based on the character of the residents as well as the class of buildings and their use. Group A is composed of business and manufacturing interests and consequently has only a small output of household refuse.

CLASSES OF REFUSE

Group B is made up of residences and high grade apartment buildings, the homes of the wealthy. The help employed is wasteful, the ashes are not sifted and the garbage output is above the average. Steam and hot water heat are used for the most part. The output of ashes is large in summer because hot water heaters are operated. Anthracite, semi-anthracite or Pocahontas coal is the fuel used.

Group C includes houses and flats or apartments occupied by the middle class. The residents are economical and to a considerable extent sift their ashes and burn the cinders. Steam, hot water and furnaces furnish the heat. During the summer season the ash output is from hot water heaters, gas being used for cooking purposes. The output of garbage from this group is relatively small contrasted with that of group B.

RESULTS OF ANALYSIS IN POUNDS OF SIXTY LOADS OF REFUSE IN CHICAGO

	Ashes				Glassware				Metals						Rubbish													
Groups	Number of loads	Fine ash passing ⅜-in. screen	Ash rejected by screen	Clinker	Number of bottles	Weight of bottles	Broken glassware	Broken crockery	Cast iron	Sheet iron	Brassware	Wire	Tinware	Enamelware	Newspapers	Manila paper	Cardboard	Mixed paper	Rags	Rubber	Leather	Wood	Brick	Grass	Yard cleanings	Garbage	Totals
A	1	1,153	1,278	248	56	43	93	11	5	.....	..	...	39	5	127	44	107	95	49	..	65	64	16	.....	.....	308	3,750
B	7	6,390	4,085	607	759	472	308	256	76	188	..	31	733	102	833	300	455	627	199	20	64	331	359	1,982	3,664	360	22,442
C	12	12,574	8,798	918	1,008	559	591	574	239	311	..	114	1,460	160	1,324	484	598	1,236	507	..	165	690	512	2,946	2,865	704	38,329
D	12	12,499	9,402	157	861	540	740	498	123	401	3	220	1,903	161	1,031	514	582	1,101	490	..	217	570	566	1,163	3,914	835	37,630
E	14	14,013	6,978	128	761	425	670	523	138	976	..	171	1,237	223	1,373	463	641	1,742	658	4	323	1,048	744	690	8,890	2,087	44,145
F	7	6,674	4,609	156	441	255	383	253	40	246	..	70	707	67	714	286	314	820	303	13	123	694	428	843	2,559	1,168	21,725
Totals	53	53,303	35,150	2,214	3,886	2,294	2,785	2,115	621	2,122	3	606	6,079	718	5,402	2,091	2,697	5,621	2,206	37	957	3,397	2,625	7,624	21,892	5,462	168,021
Average per load		1005.7	663.2	41.77	73.32	43.2	52.92	39.91	11.7	.40	.005	11.43	114.7	13.54	1.02	39.45	49	106.1	41.62	.07	18	47.1	49.53	14.38	413	103	3,170.3
Percentage per load		31.41	20.92	1.32	2.31	1.36	1.67	1.29	.37	1.26	.0015	.36	3.62	.43	3.22	1.24	1.55	3.35	1.31	.0002	.56	1.49	1.56	.45	13.03	3.25	....

Group D is composed of houses and tenements occupied by the laboring class. These people are economical, heat by stove, sift their ashes, and use both bituminous and anthracite coal. They also burn such combustible refuse as is available for heating purposes. During the summer season they use gas, bituminous coal and wood as fuel for cooking.

Group E is made up of tenement houses occupied by the working classes who are foreign and still use their native language. These people are careless about littering the streets and alleys and fail to comply with notices served to correct violations of city ordinances. Analyses show them to be careless also about separating garbage from other refuse. They are not wasteful, however, but on the contrary, very saving in every way possible. Stove heat is employed, about 75 per cent of the coal burned being bituminous and of the cheapest kind. The resulting ash is of little calorific value. In seven of the nineteen wards a large amount of wood is used as fuel. During the summer season wood and coal are used for cooking purposes.

Group F is composed of the homes of a mixed population of native white, foreign born and colored people, also of cheap rooming houses occupied by persons who do light housekeeping. They are careless about littering the streets and alleys and separation of garbage. Wood and bituminous coals are used for fuel during all seasons of the year.

GROUP G

Group G (not included in the accompanying table) is made up of the homes of a mixed population of American and foreign born persons ranging from the middle to the laboring class. No separation of garbage from other refuse is asked, owing to the inaccessibility of these districts to the reduction plant. All grades of coal and wood are used for fuel.

In one of the 60 loads no ashes were found. Seven loads in group G were not used in the table owing to the non-separation of garbage from other refuse. The loads averaged 5 cu. yd. each.

In certain wards there were proportionately larger amounts of combustible refuse than in others, due to ward burners not being operated and to the frequency of service given, whether daily, twice a week or weekly. In many localities the residents have portable rubbish burners. In a large number of apartment buildings there are installed crematories in which both garbage and rubbish are consumed. This is particularly true during the winter season.

The total weight of rags in the sixty loads analyzed was 2640 lb. They were obtained largely in wagons from ward groups B and C representative of the wealthy and middle class. In wagons of groups D and E but small quantities were found. Rag pickers with their carts of about a cubic yard capacity flourish in the former groups.

OLD NEWSPAPERS

It is difficult to secure a reasonably accurate estimate of the output of newspapers rejected by the public. Janitors, generally, save, bundle and hold papers until they acquire a considerable quantity, which they sell to paper or junk dealers. Both in the case of elevated railroads and steam roads carrying suburban passengers, at each terminal the papers are gathered, baled and sold in car-load lots. The total circulation of the daily morning and evening papers is 1,265,400, weighing 1660 tons. Based upon these figures the annual tonnage would be nearly 520,000 tons. Added to this are the Sunday editions, bringing the total very close to 600,000 tons per year of this sort of refuse.

Peddlers canvass the districts embraced in ward groups B and C offering brooms and other household articles in exchange for fairly good old shoes. These are sold to a class of cobblers and small dealers who repair and sell them at a small price. Discarded shoes from the other groups are of practically no value, having been worn beyond repair.

Little metal of any kind was obtained in the loads analyzed. Cast iron and scrap iron were to a small degree in evidence. This class of waste is generally sold by householders and janitors to junk dealers.

Rubbish in the streets and in the alleys is picked over by a class of men who gather anything that has a ready commercial value. The number of men who are thus employed is large; nearly all junk dealers are ready to furnish them with carts or bags. The work is systematized, the men working in definite districts.

Recovery of Valuable Matter

Trade waste is a term applied to refuse discarded by factories, manufacturers, hotels, and other places of business, which is not removed by the city. From this class of refuse practically everything of value is extracted by the owner, janitor or a contractor. Certain owners or agents have the cinder output removed from their premises without cost under private contract, by including their salable refuse. Garbage from hotels, cafes and restaurants, rich in meat grease and bone, is of commercial value and is sold or given in exchange for soap or other articles of value.

In the sixty loads analyzed fine ash, cinder and clinker comprised 49.3 per cent by weight of the whole, and rubbish the remainder. Rubbish, excluding garbage, was 29.8 per cent of the whole. The weight of ashes per cubic yard was 1185 lb. and the percentage of combustible material was 58.3. The material having a commercial value was 14.8 per cent.

The weight per cubic yard of rubbish is considerably higher than that of other cities, due to its containing yard cleanings and larger amounts of garbage. The term "yard cleanings" used in the Chicago classification of waste does not appear in the reports of other cities. This material remained in the screen in the analyzing process and was separated from the cinders by picking.

The Space Available in the lower portions of five reinforced-concrete chimneys completed recently for the Havana Railway, Light & Power Company, Havana, Cuba, has been utilized for storage rooms. As all chimneys are located inside the power house to economize on space two storage rooms were provided in each chimney. At an elevation 18 ft. above the top of the foundation a floor was placed and the chimney was provided with a doorway. Another floor was built giving 36 ft. above the top of the foundation another storage room. The outside diameter of the chimneys at the base is 20 ft. 6½ in. and the wall thickness is 19 in.

Routine Tests for Determining Strength of Mortars

Method Involves Use of Diagonally Mounted Mixing Box and 2 x 4-In. Cylindrical Test Pieces

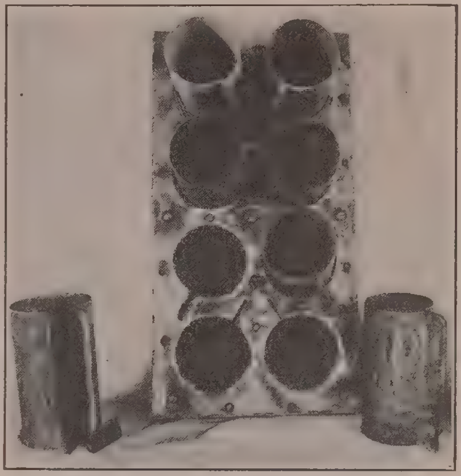
By HAROLD PERRINE
Department of Civil Engineering, Columbia University

Numerous variations in test details adopted by different investigators for the determination of the properties of the fine aggregate in concrete have led to doubt, frequently, as to the proper course to pursue in this class of inspection. Non-uniformity is noticeable to a marked extent in the methods followed in the strength tests of mortars. Other determinations, such as percentage of silt, fineness, specific gravity, etc., while of equal or perhaps greater importance than that of strength tests proper, will not be treated of in this article.

The writer has established a method for his own use in strength tests with a view to duplicating working conditions at a minimum expenditure of time. An attempt has been made to comprise as many as possible of the advantages of all published methods to the exclusion of unnecessary data. Several innovations have proved profitable.

Consistency of Mortars

There seems to be a tendency toward a general opinion that test mortars should be prepared with a consistency approaching that obtaining in concrete, mixed and placed under working conditions. Normal consistency probably should be confined in its uses to cement testing and not be included in work upon fine aggregates, except as a definite means of reference. In other words, the most comprehensive results can be obtained with the mortar in a condition as nearly as possible similar to that which is intended to fill the voids in the coarse aggregate of the concrete. This condition can be best satisfied by mixing a quantity of concrete in the economical proportions and of the consistency desired, determining the percentage of water therein, and assuming this in all mortar strength tests. This procedure has for a basis of comparison, among various samples, a definite consistency readily ascertained—the amount of water that will cause a cylinder of concrete to "slump" on removal of the mold. However, if the sample of fine aggregate is not of sufficient proportion to admit of casting standard concrete cylinders a supplementary procedure may be adopted. Normal consistency is determined in some approved manner, a corresponding "viscous" consistency assumed, possibly "normal plus 50 per cent," and this percentage used throughout.


MOLDS FOR TEST SPECIMENS

MIXING BOX MOUNTED DIAGONALLY

Mixing Apparatus

The writer's method is to place the measured quantities of cement and fine aggregate in an 8 x 8 x 12-in. watertight box, mounted diagonally on a shaft in a manner analogous to that of a common cubical concrete mixer. The ingredients are turned over for 1 min. Water is then added and the mixing continued for 2 min. longer. When the box is opened, the mixture is found to be in a condition which will admit of pouring into the molds and having the appearance and characteristics of workable mortar. No tamping is necessary, the mortar being stirred while being placed, by means of a small stick or glass rod. Forms should always be sealed at the bottoms in such a manner as to confine all the water used in the process of preparation.

The mortar should be cast as specimens for compression tests, as this direction of loading is doubtless preferable to any other. The specimens should have a height at least twice any transverse dimension in order to obtain an accurate idea of their strength. Test pieces used and found entirely satisfactory are cylinders 4 in. high and 2 in. in diameter. They are cast in forms, shown in one of the illustrations, and tested in sets of four. A thin coat of plaster of Paris is applied to the compression faces before testing. A ball and socket bearing-block is used to insure uniformity of loading.

Lead Wool for calking flexible-joint pipe lines was tried unsuccessfully in the experimental work done in connection with the Narrows Siphon across New York Bay, according to T. H. Wiggin, senior designing engineer of the New York Board of Water Supply. In discussing the subject at a recent meeting of the American Society of Civil Engineers Mr. Wiggin stated that in spite of repeated experiments the Board of Water Supply had found it impossible to get a joint suitably watertight without making it so rigid that it could not be turned. The time required for calking with lead wool was also an important objection to its use.

Test Pavement of Creosoted Blocks at Kansas City

U. S. Forest Products Laboratory at Madison, Wisconsin, Is Co-operating with Western City in Trying Out New Method

In order to demonstrate on a commercial scale the practicability of the modified method of creosoting paving blocks, cutting the amount of creosote used to a minimum, the U. S. Forest Products Laboratory at Madison, Wis., is co-operating with the city of Kansas City, Mo., on a test section of pavement near the new terminal. Half of the blocks are put in according to the city's standard specifications. The other half are treated according to the method worked out in the laboratory. They were perfectly dry when placed several months ago, and as it is impossible to have any bleeding in the winter the experimenters are waiting for warmer days to determine whether any trouble will be encountered from oil oozing from the surface of the blocks laid by the new method.

THE PROCESS

It was thought at the Forest Products Laboratory that the bleeding is due to air contained inside the blocks, and that in order to treat the paving blocks satisfactorily the air must be removed before the oil is put in. The following process, therefore, is followed: The blocks are steamed when green in order to reduce the amount of moisture to a minimum. When they are steamed dry they assume a maximum volume. It has been found that the treatment of green blocks is perhaps better than the treatment of the dry blocks. After the blocks are steamed a strong vacuum is created and the air sucked out of the blocks; a 26-in. vacuum is kept up for about an hour. The cylinder containing the blocks is then filled with the preservative, and when the desired absorption is obtained—about 16 lb.—another vacuum is created, somewhat higher than the first. The vacuum is made higher in order to dry the blocks and clean them up. Where mixed tar and creosote, half and half, are used, the blocks are steamed in order to clean them a little more than they could be cleaned by the higher vacuum process.

One or two of the large wood-preserving companies are already using the new method.

The bleeding and swelling of yellow-pine paving blocks was discussed by C. H. Teesdale, of the U. S. Forest Products Laboratory, Madison, Wis., at the last convention of the American Society of Municipal Improvements, his paper being abstracted in the Engineering Record, Oct. 17, 1914, page 444.

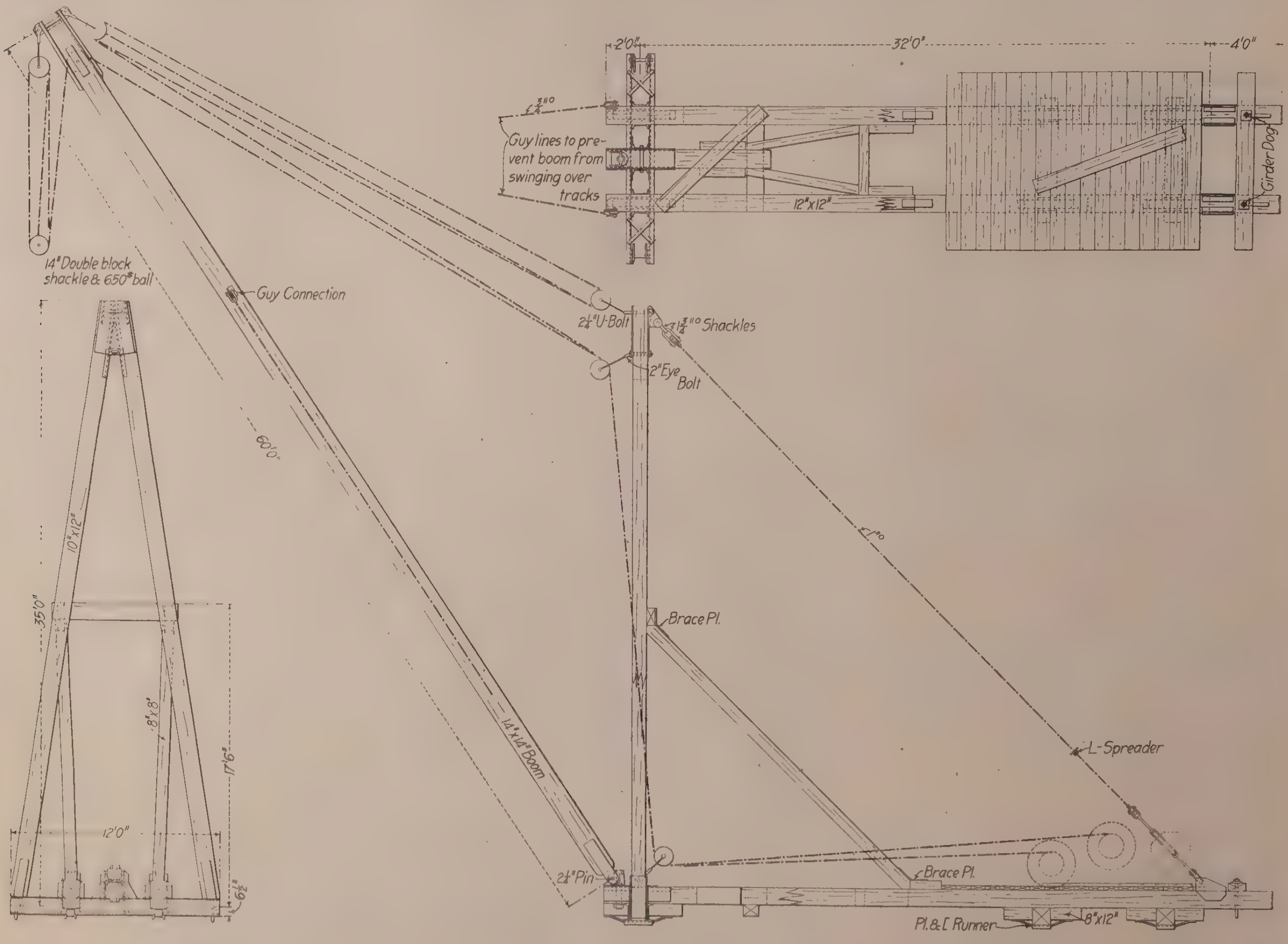
Rapid Steel Erection on Third Track Work, Second Avenue Elevated, New York

Plate Girders Set at Rate of 155 Tons a Shift by One Erection; Crew Working With Special Traveler and Organization

On the work of third-tracking the Second Avenue elevated line of the Interborough Rapid Transit Company, New York, which is being done by the Terry & Tench Company, Inc., some rapid progress in steel erection has been made, due to the use of well adapted equipment, and to good organization of the working force.

THE PROBLEM

The problem consisted of placing the stringers for the third-track between the two present tracks carrying the usual traffic. Cross-girders designed to carry three tracks were already in place. Neither of the outside tracks could be used by the contractor, and no material could be handled over them. The steel, therefore, had to be hoisted up between the two present tracks, and placed by a traveler following behind the erection. To avoid the delay of waiting for track to be laid, a traveler was designed, having on its bed-frame steel shoes which fitted over the top flange of the new center-track girders. These flanges are smooth, containing no rivets. As soon as a new



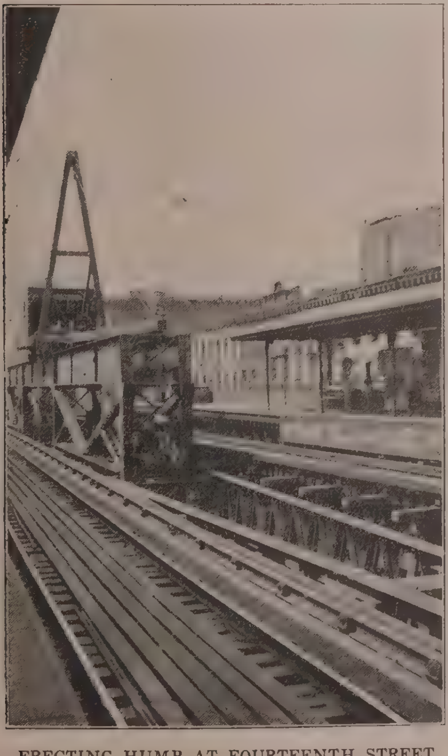
DRAWING OF SPECIAL A-FRAME TRAVELER USED ON THIRD TRACK WORK, SECOND AVENUE ELEVATED pair of girders was set and bolted, this rig could at once be pulled onto them, in place to set the next pair of girders.

Other features of this traveler, a sketch of which is shown herewith, are its narrow clearance lines, made possible by the fact that its maximum drift in swinging to set a girder was limited to 2 ft. off its center line; and its general lightness and the ease with which it could be erected and moved. The traveler was equipped with a two-drum electric hoist, taking direct current at 600 volts from the third rail of the elevated tracks. The whole rig was easily slipped ahead a panel at a time with two parts of manila rope running from a winch-head on the hoist through a snatch block hooked over the next cross-girder ahead, and dead-ended on the right side of the traveler. Slack wire guy lines from the sides of the bed-frame to the boom removed all danger of the latter's swinging to either side far enough to interfere with passing trains.

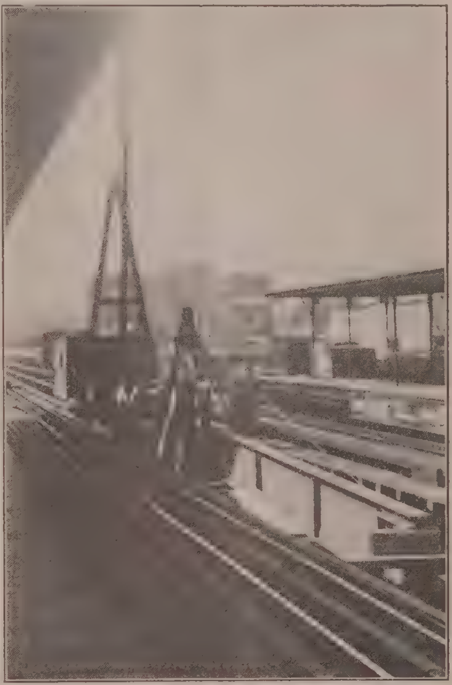
DELIVERY OF STEEL

This traveler, starting at Broome and Allen Streets, laid all the center-track steel to Sixtieth Street, with the exception of a section already in place on Twenty-third Street between First and Second Avenues. Steel was delivered by lighters to the dock at East Twenty-third Street. Six men, assisted by the crew of the lighter, unloaded the steel, sorted out the girders in the order in which they were wanted, and laid them on the dock. Four-horse swing trucks backed over the girders, which were picked up 8 or 10 in. off the ground in chain slings by a hand crab mounted on the truck. As the trucks, owing to the heavy traffic in that part of Manhattan, had to follow prescribed routes it was necessary for the girders to be slung with the proper end to the front, so that they would not have to be turned after reaching Second Avenue.

This section of the Second Avenue elevated is supported on columns just outside the street-railway tracks, between each pair of which are lattice girders, corresponding to the floorbeams of a bridge. When traffic permitted, the truck drove on the car tracks, directly beneath the panel where the girder it carried belonged, dropped the girder and drove off. The traveler then raised the girder into place. When this was not possible the girders were dropped at the curb and dragged to a point under the traveler boom with a runner line from the hoist. To protect the girders and pavement during the dragging, they were set on wood blocks which had slots in them to receive the girders flange angles, and which were prevented from slipping along the girder by bearing against the stiffener angles of the girder web.


ERECTING HUMP AT FOURTEENTH STREET

The bearing of the girders on the old floorbeams consists of a heavy box section spanning the floorbeam between the adjoining ends of the girders, the bottom of which bears on the top flange of the floorbeams, and the top of which is continuous with the top flange of the girders. The bottom flanges of adjoining girders are connected by a bent steel strap passing under the bottom flange of the floorbeam. All holes for connections to the floorbeams had to be drilled in the field.


RAISING A THIRD TRACK GIRDER

Floorbeam connection shown in right foreground.

ERECTION AND RIVETING

While the girders were being hoisted into place two men rigged the runner line for pulling ahead; and as soon as sufficient bolts could be put in to hold the girders, the traveler was moved out on them in place to set the next pair of girders.

The drilling gangs, of which there were two, followed behind the traveler drilling the field connections. The riveting gangs followed the traveler also, riveting the X-bracing and laterals, and driving the floorbeam connections as they were drilled. Three riveting gangs were employed until the riveting fell behind on the last of the work, when five gangs were put on to clean up. The bracing and laterals were light enough to be hoisted with a hand line, and the traveler was never held to set them.

At the Fourteenth Street station the center track is raised on columns resting on the old floorbeams, and cantilever platforms on each side of the center track overhang the two outside local tracks. This was done to provide platform room, as the width of the street at this point would not permit the three tracks and platforms to occupy the same level. The traveler was carried right over the top of this "hump," setting the columns and girders a bent at a time. The platform steel was put in afterward. In this section, from Thirteenth Street north for twenty-three panels, old center-track stringers had to be removed before the new steel was put in. These girders were burned off at their floorbeam connections, lowered to the street by the traveler and removed by the same trucks that hauled in the new steel.

TRAVELER JUST AFTER MOVING AHEAD

The only plant used on the work beside the traveler was a 50-hp motor-driven air-compressor, mounted on a wide-tire steel frame truck, and enclosed in a canvas tent, which followed the work on the street below and supplied air for the drilling and riveting gangs.

RATE OF PROGRESS

The best run on the work was accomplished between Fifty-first and Sixtieth Streets, where fifty-four panels (108 girders) weighing 466 tons were erected in three 8-hr. days, on Nov. 23, 24 and 25. The 1728 field holes, averaging a 1-in. grip, for these spans were drilled in seven shifts, and the 5400 rivets and 2160 permanent bolts put in in six and one-half shifts. During this run two lighters were in service, and sixteen trucks, which arrangement delivered the steel as it was wanted, and without delaying the erection.

This work was under the general charge of W. R. Coppage, superintendent for the Terry & Tench Company. A. L. Manthey was the foreman in charge of erection. George H. Pegram, chief engineer of the Interborough Rapid Transit Company, has general supervision for the Interborough of all erection work.

WEIGHT OF STREET DIRT in Chicago per cubic yard, wet and dry, was recently obtained on different kinds of pavement by the Bureau of Streets. From an asphalt pavement dry sweepings weighed 806 lb., and wet sweepings 1252 lb. Corresponding figures for other types are: Brick, 1015 and 1425 lb.; granite blocks, 1100 and 1503 lb.; oiled macadam, 1330 and 2040 lb.

Letters to the Editor

Gypsum Block in the Edison Fire

SIR: In the illustrated article on the disastrous fire at the Edison factory in your issue of Dec. 19, 1914, page 660, you make the following statement regarding gypsum blocks: "Plaster blocks were used extensively around stairways and did not withstand the conflagration."

This association feels that such a statement must be challenged in the interest of the truth and in justice to a meritorious material of construction which gave a very excellent account of itself in the Edison fire, under the most severe conditions. In support of this the following facts are submitted for consideration:

In the southwest corner of the office building a monolithic gypsum construction 2 in. thick, reinforced with light ¾-in. channels, which inclosed the stairways, withstood the fire admirably and remained practically intact on all floors.

In building 15, gypsum-block walls dividing areas on the second floor withstood the effects of the fire and remained virtually intact.

In building 13, hollow gypsum-block walls 3 in. thick, inclosing the elevator and stairways, are practically intact on all floors.

In building 7, a division wall across the building, separating machinery from the remainder of the building on the first floor, was intact, although a fire door in this wall was burned through.

At the north end of building 11, gypsum-block walls inclosing a stairway were intact on all floors. At the same end of this building on the ground floor a gypsum-block wall framed into I-beams, the flanges of which were exposed, was largely broken down in consequence of the exposing of the flanges of the steel framing. It was in this building that the reinforced-concrete columns on the first floor were so badly shattered that the building had to be shored up to prevent collapse.

In building 24, at the east end of the building, gypsum-block inclosures of elevator and stairway were practically intact on all floors. It was in this building that 20 tons of wax was stored and created unprecedented temperatures. In this same building the inclosure of the stairway located in the extension on the south side, constructed of gypsum blocks, was practically intact.

It is well understood that the severity of this fire was unusually great, owing to the large amount of highly inflammable materials present in large quantities in the burned buildings. In some cases, in three or four of the buildings—the writer was so informed, but did not see them during his inspection of the building—gypsum walls were wrecked, but it was not stated whether such conditions happened by the falling of heavy bodies, or by what manner such wreckage occurred.

In providing for fire protection gypsum-wall construction can be used to great advantage for dividing areas and for inclosing stairways and elevator shafts, etc., and the more freely it is used for these purposes the more effectively will the building be protected against the spread of fire. The use of gypsum construction for such purposes in proper thicknesses for various heights and lengths has received sanction by the many successful tests conducted by the Underwriters' Laboratories and other institutions, and by the long successful record in fires and conflagrations.

GYPSUM INDUSTRIES ASSOCIATION,
By S. G. Webb, Secretary.
New York City.

SIR: My attention has been drawn to a statement in your description of the Edison fire in your issue of Dec. 19, 1914, page 662, of which the following is a quotation: "Plaster blocks were used extensively around stairways, and did not withstand the conflagration."

The above statement does not conform with reports in my possession from disinterested sources, nor is the statement corroborated by the evidence of photographs in my possession, which show that gypsum partitions remained intact throughout the fire, and that, on the whole, the behavior of gypsum, in many cases, is better than that of reinforced-concrete beams and columns.

A statement of the nature of that quoted works an unintentional injury to the large and increasing use of gypsum in this country, and unless borne out by substantial evidence, should certainly be retracted. As an illustration of the influence exerted thereby I would draw your attention to the fact that the expression of your paper was copied in the Kansas City "Star" of Dec. 25.

For your information I might state that in my engineering practice I have advanced the use of gypsum for elevator and stairway inclosures, steel protection, partitions, roofs and floors in fireproof building construction, and that this type of construction is allowed in New York City, Pittsburgh and other cities and in some of the larger State building codes. If gypsum partitions failed, then they were either improperly erected or of insufficient thickness, which might be the case with any other material.

VIRGIL G. MARANI, M. Am. Soc. C.E.,
Cleveland. Consulting Engineer.

[As stated in the Engineering Record last week, page 37, the statement to which Mr. Webb and Mr. Marani object was too sweeping. The gypsum blocks on the whole stood the conflagration well. There were failures, but evidence is not available as to the mechanical agents which may have been factors. Fire streams certainly played a part in one case.—EDITOR.]

Efficient Use of Surplus Blueprints

SIR: The spirit actuating the disposal of the discarded blueprints and sketches among employees, explained by Mr. Jones in the Engineering Record of Dec. 19, 1914, page 672, is indeed a commendable one, and introduces a plan deserving of adoption in all quarters where conditions may justify. It would seem, however, that a phase of the operation of such a plan, particularly in larger organizations, has been overlooked, and one which might act as a serious demerit to the results anticipated. This is the promulgating of company business and ideas to apparently limitless ends, which, naturally, does not work always to best advantage.

The ideas and data set forth on these sketches, blueprints and the like have a certain amount of utility to the company, and are company property; money has been expended for brains and labor to bring them to a conclusion, or to a point where conditions show that the plan is not feasible. While possibly of no immediate or even future value to this company, there is reasonable likelihood that they might be of service to other concerns in a kindred field of activity. There is no successful organization existent, engineering or otherwise, that does not embody methods, ideas and policies of operation that are essentially to be kept as confidential. There are many open books, but behind the pages there are features also that are to be kept closed.

Again, it cannot be held that once an employee always an employee; employees come and go, and with them, with this scheme in vogue, go these sketches and plans of their former employer. In the change of environment which ensues these plans and ideas, or the substance thereof, find their way into the realm of other offices. They carry items of value, or else they would not have been preserved by the employee. Every man worthy of hire has a certain amount of self-interest; he seeks to benefit both employer and himself. Activity of this character cannot be productive of ultimate good to the former employer; on the contrary, it may prove harmful, working to particular disadvantage in some division of endeavor.

It is not in any manner assumed that the underlying motive for a collection of such data by the employee is other than that inspired with honorable intentions; but time changes many things, and facts must be looked in the face. It seems reasonable that where a company makes an investment for the carrying out of a plan or idea, such plan or idea should not be distributed broadcast. The limit of distribution should be a judicious one, and effected with a view to the utmost protection of company interests.

Newark, N. J. L. R. W. ALLISON.

INSTALLING 3749 METERS IN DETROIT during the year ended June 30, 1914, cost $1,553.24 for labor and cartage and $27,345.95 for material. Segregated according to size, 2343 ⅝-in. meters cost 38 cents each for labor and cartage and $5.67 for material; 977 ¾-in. meters, 38 cents for labor and cartage and $8.35 for material; 292 1-in. meters, 48 cents and $11 for the two items respectively; 42 1½-in. meters, $1.69 and $22, and 49 2-in. meters, $1.64 and $36. Meters 3 in. and larger in size were set by consumers but no labor time is available.

There were 6079 new meters installed and 2330 meters removed, making a total of 17,051 meters in service. This represents 12.8 per cent of all the services, while the quantity of water passed is 41.9 per cent of the total consumption. These meters produced 47.3 per cent of the revenue derived from the sale of water.

Costs of testing various sizes of meters are given in the accompanying table.

COST OF TESTING METERS IN DETROIT

Size, inches	Number	Flow	Cost	Average
⅝	3795	Full to 1/32 in.	$298.84	$0.08
¾	1485	Full to 1/32 in.	119.64	0.08
1	597	Full to 1/32 in.	62.89	0.10½
1½	71	Full to 1/16 in.	18.81	0.26½
2	74	Full to 1/16 in.	19.62	0.26½
3	32	Full to 1/16 in.	35.84	1.12
4	12	Full to ⅛ in.	13.71	1.14
6	11	Full to ⅛ in.	14.82	1.35
8	1	Full to ⅛ in.	2.16	2.16
10	1	Full to ⅛ in.	2.70	2.70

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Floating Mixing Plant with Tower for Concreting on River Work

AN unusual mixing plant was built last summer and used till the end of the season for concreting of Government dam No. 12 on the Ohio River. On a hull 30 x 75 ft. with 5-ft. sides was erected a 74-ft. Insley tower, on the center line of the hull and 12½ ft. back from the bow end. Behind this was placed a Lakewood mixer of 1-yd. capacity, fed by gravity from material bins. In order to avoid carrying unnecessary weight on the boat, which had to be left light when idle, it was desirable to arrange these bins to drain completely by gravity. Therefore, they were built with a vertical front face, and sides and back sloped 45 deg. To approach the floating capacity of the hull, which was desirable in order to insure continuous operation in case of an accident to the derrick boat supplying the bins, the latter were designed for 140 yd. of material. This made a very high structure, even after cutting down head room by dropping the tower bucket into a pit cut in the deck, which enabled the mixer to be set flat on the deck. The bins extended across the hull, being 20 x 30 ft. in plan and 30 ft. high from deck to top plate.

To insure stability, the sand and gravel bins were made the same size and the center of gravity of the bins located 1 ft. forward of the center of flotation of the hull. Material was drawn from the bins into measuring hoppers which discharged directly into the mixer drum. Water was supplied from the river by a boiler feed pump, and was measured in a gaging cask, pivoted in the center and placed where it would discharge into the sand hopper when turned over. The operating platform was built around the tops of the measuring hoppers, and provided with levers for charging both the measuring hoppers and the mixer, and bells for signaling the operators of the mixer and the tower hoist. Cement was handled in skips by the derrick boat onto a platform at the level of the operating platform, and behind the bins. From there it was wheeled to the measuring hoppers.

MIXER BOAT READY TO CONCRETE

The mixer and tower hoist were supplied with steam by a 60-hp locomotive boiler located, with its 8-ton coal bunker, on the stern of the boat. The tower hoist was a two-drum double-cylinder skeleton, with one line handling the tower skip and the other the spout boom. This hoist was placed 8 ft. off center on the port side, under the main bin.

The spout boom was an original feature, being an A-frame mounted on the forward corners of the hull. Its boom fall was fastened to the top of the tower. The outer end of the first length of chute was hung from the apex of the boom by a wire rope handled on a winch head of the hoist. Except while adjusting the slope of the chutes, this line was clamped off around a timber head.

The tower was equipped with an Insley hopper for charging the chutes, about which was built an operating platform. The chutes were of Lakewood and Insley make. Beyond the end of the boom they were supported by gin-poles. With the river at El. 614, concrete was spouted a distance of 140 ft. into a form whose top was at about El. 630.

The hull had to be reinforced with two new keelsons, making four all told, all of which were securely trussed with 1-in. steel rods to distribute the load from the main hoppers. The boat, contrary to expectation, proved exceedingly stable and floated when in operation almost on an even keel, drawing about 4 ft. when fully loaded.

The boat's best sustained runs averaged 30 yd. an hour, although it has put in more than 40 yd., and could keep up this rate under more favorable conditions than those under which it worked last fall. The labor cost of mixing and placing concrete, taken over weekly periods, ran from 55 to 90 cents per yard, the latter cost being for a few forms so far away from the outside of the cofferdam that the concrete had to be rehandled into them with a derrick.

River Pipe Line Laid without Cofferdam

WITHOUT resorting to the use of a cofferdam a 12-in. cast-iron pipe line has been laid across the Lehigh River at Easton, Pa., by the South Easton Water Company. The stream at the point of crossing is about 700 ft. wide and the greatest depth of water is 5 ft., the average depth being about 3 ft. Obviously with the scheme of construction decided upon it would have been impossible to pour lead joints on account of the presence of water. The bolted type of joint on the Central Foundry Company's Universal cast-iron pipe lent itself readily to the work at the river crossing and was used. The pipe, in 6-ft. lengths, was floated out on a wooden raft, as shown in one of the pictures. The end of the line already in place was raised to the water surface—for the joint affords a certain amount of flexibility—and the new section was added, the only tool used being the ratchet wrench generally employed on such work for tightening up the bolts. Six-foot lengths were used to facilitate handling.

DELIVERING PIPE TO PLACE ON A RAFT AND RAISING END OF LINE TO RECEIVE NEW SECTION

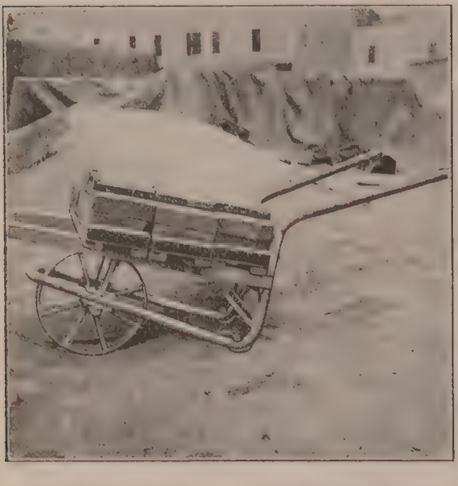
Saving Money in Laying Brick

During the past summer the Aberthaw Construction Company, of Boston, has been called upon to erect five or six brick buildings, amounting in the aggregate to several million brick. Studies in saving labor on this work have been divided into three parts: First, keeping careful cost records on two buildings erected in Connecticut with the usual hods for carrying brick and mortar; second, cost records on the use of special brick-carrying devices on a group of buildings in Maine; and finally, an extension of the above studies to yet more refined methods on another building in Connecticut. The principal effort so far has been to improve the methods of transportation.

Brick were received by rail. When a car had to be unloaded faster than the brick could be used on the job, the brick were thrown in a pile. When, however, brick could be moved directly from the car to the job, they were loaded in the car upon wooden trays such as those shown in the accompanying cuts. Each of these trays was made to hold 18 brick, there being ten set on edge in the lower row, and six on edge and two flat in the upper row. It was found possible to carry three trays, or 54 brick, upon each wheelbarrow, with no more fatigue on the part of the man than he experienced in the carrying of a hod of sixteen brick. This means that the brick were carried more than three times as rapidly, or that three times as many brick could be transported the same distance by the same force.

On the Maine buildings the brick were carried up an inclined plane to the scaffolding around the building. This proved just as easy for the man as carrying a hod up a ladder, and still retained the advantages of handling more than three times as many brick per man. The barrow, as will be seen from the illustrations, is an adaptation from the ordinary scoop barrow used for handling broken stone, lime, sand, etc. The handles have been made of one long piece of one-inch wrought iron pipe, bent in five places, and fitted with the necessary braces, journals, etc. These barrows have the advantage of placing the center of gravity of the load very close to the axis of the wheel. Mortar is handled—3 trays to a barrow, the load weighing about 80 lb. The trays have a sheathing of zinc around the bottom to keep the water from leaking out, and iron handles.

On the Connecticut job no inclined plane was used, all brick and mortar above the foundation being sent up in elevators located at two corners of the building. With a speed of travel of about 50 ft. per minute, loads were carried up at intervals of eleven seconds. The man with the wheelbarrow loads his trays upon the elevator at the bottom, while one man at the top takes them off and two other men distribute them to the masons working on the platform. By the combination of the wheelbarrows and the elevators, the same gang of eighteen masons who used eighteen helpers on the first job were able to lay more brick per day with from nine to eleven helpers. One refinement of the system has been the loading of the brick upon the trays all with one side to the right. The mason, upon picking up the brick, knows exactly how it is going into the wall, without having first to turn it over in his hand and find the "right side up."


BRICK TRAYS ON WHEELBARROW

BRICK TRAYS ON WORKING PLATFORM

Shaft Sinking with Jack-Hammers in Tough Rock

A FEW years ago the development of extensive ore deposits to the north of the Mary Mine of the Ducktown Sulphur, Copper & Iron Company, Ltd., in Polk County, Tenn., made necessary the immediate sinking of an entirely new operating shaft to a depth of 800 ft. Later the continuation of this sinking to a total depth of 1200 ft. was found necessary. This working is called the Gordon shaft, and was described by William Young Westervelt, consulting engineer, in a paper before the American Association for the Advancement of Science at Philadelphia, Dec. 30 and 31.

No water difficulties were encountered, and sinking would have been accomplished without trouble but for the extreme toughness of the gray-wackes and mica schists penetrated. Not only did hardness from the silicification and pressure to which these rocks had been subjected make drilling extremely slow, but the mica and hornblende crystals woven through its structure made it very tough and difficult to blast. Consequently, an excessive number of holes and a very heavy charge were required for even a moderate cut. Fortunately, it was possible to drift out to the location of the shaft from five levels in the old mine, and to start raises in line with the shaft in the roof of each of these headings. These raises were made 5 ft. in diameter, while the full size of the shaft was 7 x 14 ft.

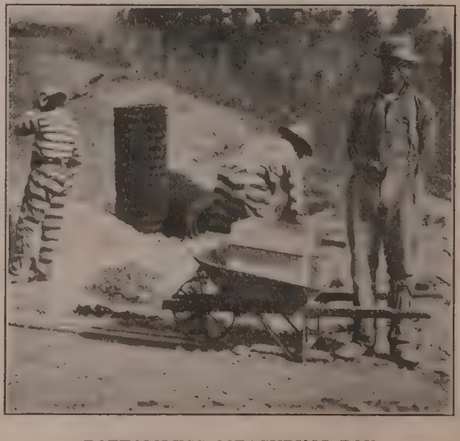
Sinking from the surface was done with two reciprocating 3-in. air drills mounted on shaft bars, making 5-ft. cuts. Material was handled by a hoist at the surface until the top of the first raise was encountered, after which it was dropped to the first level and removed in cars. The raises were reamed to full size with the same equipment. The raises themselves, however, were each drilled with two telescope-feed-hammer drills. By this method the shaft was completed to the seventh level, 629 ft. below the surface, in October, 1910, at a rate of over 48 ft. a month.

No workings existing below this depth, and all work therefore being confined to the bottom of the shaft, to sink the next 216 ft. required 13 months, or until November, 1911, an average of less than 17 ft. a month. At this point Mr. Westervelt made the change from two reciprocating to six jack-hammer drills, and reduced the depth of cut to 2 ft. per shot. The rate of sinking for the next 120 ft. jumped to 50 ft. per month, more than double the best previous month's sinking in full sized shaft. Further, the lighter shots made more even walls and facilitated better alignment of the shaft. It is expected that the shaft will be finished, and all equipment installed, in July, 1915.

The cost of sinking the shaft full size with reciprocating drills was $52.38 per foot, while to raise and ream cost $43.85 per foot. Figures on the cost of sinking with jack-hammers have not been given out, but preliminary reports indicate that they will be lower than either of these sums, in spite of trebling the number of drills operated. The work has been in charge of A. Bennett, mine captain, while J. H. Taylor represented Mr. Westervelt at the mine.

Bottomless Measuring Boxes for Sand and Stone

PART of the plant for constructing concrete roads in Fulton County, Georgia, consists of bottomless measuring boxes for sand and stone, one of which is shown in the accompanying illustration. They have the advantage that they can be used with any wheelbarrow. Thus the trouble of building special wheelbarrow bodies for careful proportioning is avoided. Moreover, only a comparatively few of these boxes are needed, whereas under the other plan a box must be built for each wheelbarrow. The photograph here reproduced was taken in November on a road being built just north of Atlanta, said to be the first concrete road in this section of the South.


BOTTOMLESS MEASURING BOX

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Arizona Alien Law, Adopted as Initiative Measure, Void

Court Holds Restrictive Measure, Under the Guise of a Police Regulation, Violates Constitutional Rights

The Arizona anti-alien employment act, adopted by the people of the State at the November election as an initiative measure, was declared unconstitutional, null and void on Jan. 7 by a special court of three Federal Judges.

"The law was intended," the court's opinion says, "to be a police regulation, but under guise of police regulation the State was in effect depriving the complainant of his right to labor, guaranteed to him by the Fourteenth Amendment to the United States Constitution.

"If under guise of police regulation a State can prohibit an employer from employing more than 20 per cent of alien labor it can prohibit him from employing more than 5 per cent, and if 5 per cent any at all.

"The Supreme Court of the United States recently has held that the right to labor is a right of property. An alien cannot be deprived of the right of property under the Constitution of the United States."

Eastern Rate Increase May Exceed 5 Per Cent

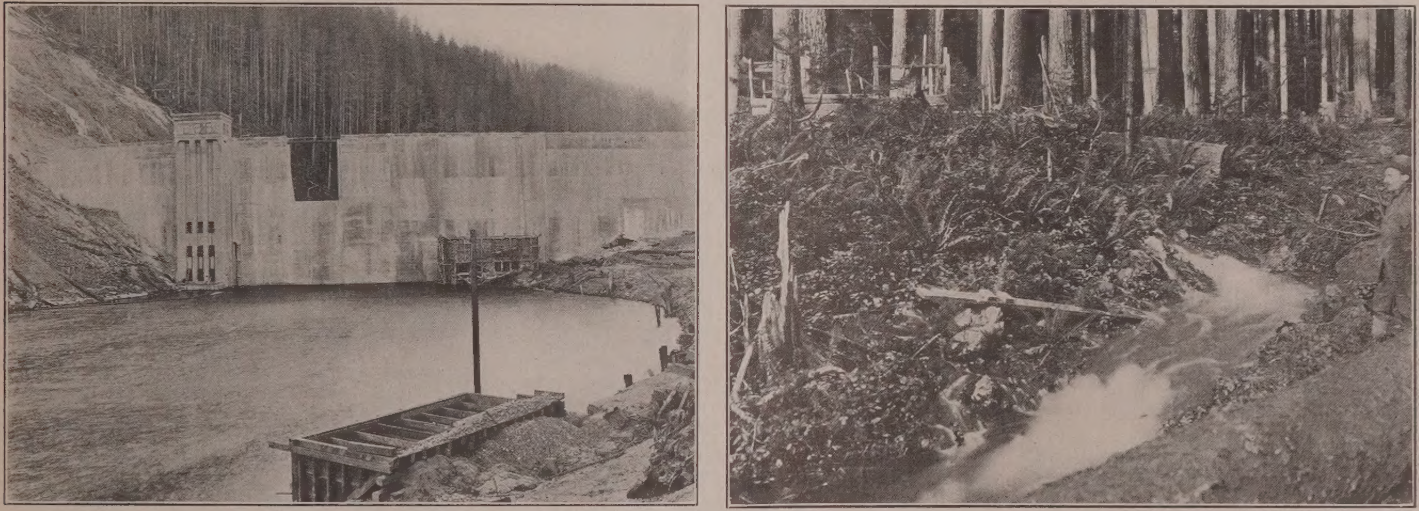
According to a supplementary order issued Jan. 8 by the Interstate Commerce Commission the Eastern railroads may in certain cases increase freight rates more than 5 per cent. This is in recognition of the desirability of maintaining existing groupings and relationships, "in the interests of carriers and of competition between shippers and receivers."

San Francisco Engineers Injured in Eight-Story Elevator Drop

Harold H. Fitting, Earl Pressy, George E. Wolfrom and J. W. Fitting, all assistant engineers in the civil engineering department of the Oakland, Antioch & Eastern Railway Company, were seriously injured on Jan. 6 in an elevator accident in the California Pacific building in which the company has its San Francisco offices. The elevator fell eight stories with a load of ten passengers; all were seriously injured and three are not expected to live.

Puddling May Stop Seepage at Cedar River Dam

The city council of Seattle has appropriated $15,000 for the purpose of stopping seepage in the vicinity of the Cedar River dam. The situation which was explained in these columns last week, is regarded as serious and it seems probable that some puddling process will be adopted to stop the flow of water. The accompanying pictures show the main dam and one of the springs which have developed below it and have caused trouble.



CEDAR RIVER DAM AT SEATTLE, AND ONE OF THE SPRINGS WHICH HAVE DEVELOPED BELOW THE SITE OF THE RESERVOIR

Assess for Sewer in Proportion to Water Consumption

Los Angeles Introduces Method of Using Water Meter Readings in Apportioning Assessment for Sewer

The city of Los Angeles has decided that a new sewer to cost about $60,000 should be laid on Maple Avenue between Seventh and Washington Streets, and expects to spread the assessment upon the basis of the water consumed. Several laundries and other users of large quantities of water are located in this district and as their presence made the old sewer inadequate and because they were the chief petitioners for the improvement, city authorities decided to adopt the new basis for assessment instead of the usual front footage rating.

Water meter readings during the past five months are now being tabulated, and although some objection to the assessment basis is expected, it is reported that the legality of the procedure has been established and those who use ten times the amount of water required by other property owners will have to pay a sewer assessment ten times as great.

American Manager Bars Secrecy in English Railroad Wrecks

American methods in English railroading were shown Jan. 1, it is stated, when London reporters and photographers were cordially received at the scene of the wreck on the Great Eastern Railway at Ilford, England, and given ample opportunity to inspect the débris and investigate the disaster. On previous occasions of this kind it is said that newspaper men have been rigorously barred from the scene. The Great Eastern is the road of which H. W. Thornton, formerly of the Long Island Railroad, was made general manager.

Daily Survey at Culebra Cut Safeguards Passing Vessels

Constant Movement at Slide Requires the Plotting of a Chart Every 24 Hours Before Ships Are Allowed to Use Channel

Constant movements of material in the channel past the slide at the Culebra Cut of the Panama Canal have necessitated daily surveys at this point and the plotting of a new chart every 24 hr. before ships are allowed to pass. An efficient method of making the survey has been developed and the following information concerning it has been received from W. E. Boyd, Paraiso, Canal Zone.

The slide extends about 2000 ft. along the canal.

Cable Across Canal

Along one bank a base-line, marked by stakes at every station and quarter station, is run at a convenient distance from the cross-section center line. Sections are taken every 50 ft. at right angles to the center line by stretching a cable from bank to bank. Readings are taken at the stations and half stations one day and at the one-quarter and three-quarter stations the next, so that stations are taken every 25 ft. every two days. The cable is graduated every 15 ft. and a sounding is taken at each mark across the canal. The reel on which the cable is wound is set up behind the stake on the base-line and the zero is located by measuring to the nearest mark on the cable. By this means each sounding is located.

Field Force

The field force consists of two sounding parties, each composed of one American engineer and ten negroes distributed as follows: Four men on the bank to handle the reel, locate zero, and give line across canal; two men in the boat with the engineer, one as leadsman and the other as oarsman; two men to assist in handling the cable across dredges, etc.; and two on the opposite bank to hold the end of the cable.

Thirty-seven sections are taken, covering a distance of 1800 ft. of canal, each section requiring a new set-up of the reel. In the distance covered, there are usually at least five dredges which must be crossed by the cable without interrupting their work. The cable has to be frequently dropped for passing boats, etc. The notes are sent by launch a distance of about 2 mi., to the office, where they are reduced and plotted by one man. The completed chart is then checked and printed.

In spite of the numerous sections, obstacles and frequent interruptions, remarkably good time is made, as will be seen by the following figures which are those of an average day's work: Time of starting work, 7.43 a. m.; time of completed print, 11.00 a. m.; elapsed time, 3 hr. 17 min.; average number of soundings, 650; time to take notes, send notes to office, reduce, plot and print each sounding, 18.18 sec.

This work is done by the engineers of the dredging division under the direction of W. G. Comber, resident engineer.

The Engineering Foundation

The Engineering Foundation will be inaugurated on Jan. 27, 1915, in the auditorium of the United Engineering Societies' Building, New York.

The Engineering Foundation is the name given to a fund to be administered for the advancement of the arts and sciences connected with engineering and the benefit of mankind, the basis of which is the initial gift of a considerable sum by a noted engineer for this purpose. The American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers are to be represented equally in the administrative board of the Engineering Foundation by election by the board of trustees of the United Engineering Society, which has been made the custodian of the fund.

Civil Engineers Will Be Represented at Constitutional Convention

At its meeting Jan. 6 the board of directors of the American Society of Civil Engineers authorized the appointment of a committee of three members to represent the society at the convention which will revise in April of this year the New York State constitution. The purpose of this representation is to make mandatory the appointment of engineers to certain specific State positions, instead of leaving the qualifications of appointees to the appointing power.

The American Institute of Consulting Engineers already has a committee at work on this matter.

Urge Sand-Washing Machine for Sacramento Filters

An energetic campaign is being carried out in Sacramento to secure the installation of the Blaisdell sand-washing machine for the water filters in that city. It is pointed out by the advocates of the machine that it has been used at Yuma, Ariz., Philadelphia, Wilmington, Del., Montreal, and Calexico, Cal.

American Society to Inspect New Subway at Annual Meeting

The sixty-second annual meeting of the American Society of Civil Engineers will be called to order at the society house in New York at 10 a. m., Wednesday, Jan. 20. Annual reports will be presented, officers for the ensuing year elected and reports from several special committees presented. After adjournment a meeting of the board of directors will be held. Lunch will be served at the society house at 1 p. m. During the afternoon, by courtesy of the Public Service Commission, the members will inspect construction work on the Lexington Avenue subway. At 9 p. m. a reception will be held at the Hotel Astor for members, the ladies of their families and guests.

Thursday, Jan. 21, will be devoted to an excursion on the Long Island line of the Pennsylvania Railroad. This excursion, on a special train, will leave the Pennsylvania station at 9.45 a. m. The excursion will visit the Sunnyside yards, Springfield Junction and the North Shore branch to Great Neck. Numerous improvements recently installed by the Pennsylvania will be seen. Beginning promptly at 8 p. m. there will be a lecture, with motion pictures, by Prof. Lawrence Kitchell on the Great National Park and on the Panama-Pacific International Exposition. This lecture will be followed by an informal smoker at the society house. On Friday following the close of the annual meeting a special meeting will be held to consider the report of the special committee on materials for road construction. It is expected that a number of engineers particularly interested in road construction will be present, and it is the intention to afford an opportunity to all who attend to present their views.

To Open Panama Canal Formally with $250,000 Fete

Tentative plans for the formal opening of the Panama Canal have been adopted. Foreign nations, including those of South and Central America, have been invited to send ships to take part in the naval parade, although the danger from slides may preclude the possibility of holding the parade through the canal. It is expected that an appropriation of $250,000 will be made to defray the expenses of the celebration.

American Railway Engineering Association Nominates Officers

Nominations for office in the American Railway Engineering Association for the coming year have been announced as follows: President, Robert Trimble, chief engineer maintenance of way, Pennsylvania lines west of Pittsburgh, Northwest system, Pittsburgh; vice-president, John G. Sullivan, chief engineer, Canadian Pacific Railway, Western lines, Winnipeg, Man.; treasurer, G. H. Bremner, assistant district engineer, Interstate Commerce Commission, Chicago; secretary, E. H. Fritch, Chicago; directors (three to be elected), F. H. Alfred, Pere Marquette; E. B. Cushing, Southern Pacific; C. F. W. Felt, Atchison, Topeka & Santa Fé; E. H. Lee, Chicago & Western Indiana; H. E. Hale, Presidents' Conference Committee; A. J. Himes, New York, Chicago & St. Louis; H. R. Safford, Grand Trunk; Thomas S. Stevens, Atchison, Topeka & Santa Fé, and Prof. A. N. Talbot, University of Illinois; members of nominating committee (five to be elected), Hadley Baldwin, Cleveland, Cincinnati, Chicago & St. Louis; D. J. Brumley, Illinois Central; Paul Didier, Baltimore & Ohio; J. A. Peabody, Chicago & North Western; S. S. Roberts, consulting engineer; L. S. Rose, Cleveland, Cincinnati, Chicago & St. Louis; Dr. H. von Schrenk, consulting timber engineer; C. E. Smith, Missouri Pacific; Prof. F. E. Turneaure, University of Wisconsin, and W. D. Wiggins, Pennsylvania lines west of Pittsburgh.

News of Engineering Societies

The Arkansas Engineering Society will hold its fourth annual meeting Jan. 18 and 19 at Little Rock.

The North Dakota Society of Engineers will hold its seventh annual convention at Minot, on Feb. 4 and 5.

The Montana Institute of Municipal Engineers will hold its annual meeting Jan. 18 to 20 at Helena.

The Alabama Association of Highway Engineers held its annual meeting Jan. 9 at Montgomery, Ala.

The Ohio Engineering Society will hold its twenty-sixth annual meeting, Jan. 20, 21 and 22 at Columbus, Ohio.

The Illinois Society of Engineers and Surveyors will hold its thirtieth annual meeting at Springfield, Ill., Jan. 27 to 29.

The Detroit Engineering Society, at its meeting Jan. 8 heard a paper by A. T. Howson on "Heavy Construction Work in Railroad Building."

The Brooklyn Engineers' Club, at its meeting on Jan. 14, heard a paper on "The Application of Electricity to Marine Transportation," by William T. Donnelly.

The Engineers' Club, of Trenton, N. J., at its meeting on Jan. 14, heard a paper on the "Geology of Trenton in Relation to Commercial Development and Engineering Problems," by Dr. Henry B. Kümmel.

The Engineers' Club of St. Louis directed a meeting of the associated engineering societies of St. Louis on Jan. 6, which was addressed on "The Economic Side of City Planning" by Henry Wright.

The Western Efficiency Society, at its annual meeting, held in Chicago, Jan. 8, elected the following officers for 1915: President, I. A. Berndt; vice-presidents, M. S. Greene and H. Thorpe Kessler; and secretary, G. H. Dent.

The Kansas Engineering Society will hold its seventh annual meeting at Topeka Jan. 19 and 20. A number of technical papers will be presented and new officers will be elected. The society headquarters will be at the Commercial Club.

The Association of Civil Engineers and Surveyors of Arkansas, at its meeting on Dec. 24, elected the following officers: President, F. O. Cook; first vice-president, John P. Harper; second vice-president, A. H. Glasscock; third vice-president, H. R. Carter; secretary, J. O. Jones.

The Philadelphia Association of members of the American Society of Civil Engineers will meet at the Philadelphia Engineers' Club on Jan. 18. The meeting will be addressed by Prof. Charles D. Marx, of Stanford University, on the Panama-Pacific Exposition and the International Engineering Congress of 1915.

The structural section of the Engineers' Society of Western Pennsylvania, meeting in Pittsburgh on Jan. 5, elected the following officers: President, Paul Woefel; vice-president, H. A. Thayer; directors, Herman Laub, W. A. Nichols and A. C. Donaldson. A paper was presented on "Emergency Dams of the Panama Canal," by O. E. Hovey.

The Eastern Arizona Engineers' Association was recently organized at Morenci, Ariz., and elected the following officers: President, F. D. Rathbun; vice-president, E. G. Jones; secretary-treasurer, Walter DuMoulin. The thirty-three engineers present laid plans for co-operating through the association for closer professional and personal acquaintance.

The Colorado Association of members of the American Society of Civil Engineers held a meeting Jan. 9 in Denver. Shirley Houghton, of the Van Sant-Houghton Company, San Francisco, western manager for the Unit Construction Company, presented a paper on unit construction of concrete structures and also on a new method of placing concrete linings in tunnels by the pneumatic method.

The Western Society of Engineers heard a paper at a meeting of the sanitary, hydraulic and municipal section, on Jan. 4 by Charles H. Smith, of the Associated Factory Mutual Fire Insurance Companies, on "The Salem Conflagration June 25, 1914." The following officers of the section were elected for the ensuing year: Chairman, G. C. D. Lenth; vice-chairman, W. W. DeBerard; members of the executive committee, Douglas Graham and J. H. Libberton.

The Pacific Northwest Society of Engineers held its annual meeting at the Arctic Club, Seattle, Jan. 2. The following papers were read: "Engineering in Business," by Gen. H. M. Crittenden; "The Outlook for Capital," by N. S. Backus; "Alaskan Railways," by J. L. McPherson; "A Note of Optimism," by Judge Thomas Berch; "The Engineer and Social Service," by F. W. Best; "A State Water Code," by Marvin Chase; and "Engineering," by S. H. Hedges.

The Alumni Association of the Massachusetts Institute of Technology has elected the following officers: President, Henry J. Horn, '88, of Brookline; vice-presidents, Walter H. Kilham, '89, of Boston, and John L. Mauran, '89, of St. Louis; secretary-treasurer, Walter Humphries, '97, of Brookline; executive committee, M. C. Brush, '01, of Boston, and W. K. Lewis, '05, of Newton. Messrs. Mauran, Brush and Lewis are elected for two years; the other officers for one year.

Personal Notes

O. H. Lange has been elected city engineer of Quitman, Ga.

Henry Goldmark and C. J. Goldmark have opened an office as consulting engineers at 103 Park Avenue, New York City.

Thomas W. Golding, consulting structural engineer, has removed his office to 25 West Forty-second Street, New York City.

Capt. Harold S. Hetrick, Corps of Engineers, U. S. Army, has been transferred from Lock 43, Ohio River, to Louisville, Ky.

Charles R. Gow, civil engineer of Roxbury, Mass., has been named as a member of the Boston Excise Board by Governor Walsh.

Adams & Cummins, consulting engineers of Detroit, Mich., have removed their offices from the Ford Building to the Kresge Building.

Capt. Richard Park, Corps of Engineers, U. S. Army, was recently ordered to report to the commanding general, western department.

Ernest E. Lathrop was recently elected city engineer of Fitchburg, Mass. He was formerly assistant engineer for the Fitchburg Sewage Disposal Commission.

Arthur G. McKee, with Robert E. Baker and Donald D. Herr, has formed the engineering and contracting firm of Arthur G. McKee & Company at Cleveland.

J. W. Leonard, formerly assistant to the president of the Canadian Pacific Railway, will be the executive head of the new terminal company at Toronto, Ont.

First Lieut. John W. Stewart, Corps of Engineers, U. S. A., will take station at New York City for duty in connection with land defense work at New York.

C. S. Coe, formerly division engineer on the Key West extension of the Florida & East Coast Railroad, has been appointed engineer of maintenance of way for that railroad.

Captain Glen E. Edgerton, Corps of Engineers, U. S. Army, has been assigned to temporary duty in connection with the work of the Board of Road Commissioners for Alaska.

August E. Christhilf, who recently resigned as president of the Baltimore Asphalt Block & Tile Company, has taken charge of the Baltimore business of the Union Paving Company.

James H. MacDonald, formerly highway commissioner of Connecticut, has opened an office for practice as a consulting engineer in the Chamber of Commerce Building, New Haven, Conn.

E. B. Carter, superintendent of maintenance of way of the Florida & East Coast Railroad, has been promoted to chief engineer of that railroad. With Mr. Carter's promotion the office of superintendent of maintenance of way has been abolished.

Major Frederick W. Altstaetter, Corps of Engineers, U. S. A., is relieved from duty in Washington and will proceed to Grand Rapids, Mich., for duty, to relieve Col. James C. Sanford, Corps of Engineers, U. S. A., of duties pertaining to the Grand Rapids Engineer district.

Harry Bortin has resigned as assistant to the general secretary of the presidents' conference committee of valuation to engage in private practice, specializing in valuation work. He was formerly engineer in charge of the valuation department of the Union Pacific Railroad.

William Barclay Parsons, consulting engineer of New York, and Daniel L. Turner, deputy engineer of subway construction, Public Service Commission, New York, have been appointed members of the advisory commission on city planning of the Board of Estimate and Apportionment of New York City.

W. W. Marr, consulting engineer of the Sheridan Road Improvement Association, Chicago, has been appointed chief State highway engineer of Illinois. He will succeed A. N. Johnson, who resigned on July 1, and is now a member of the staff of the Bureau of Municipal Research of New York City.

G. E. Mitchell has been elected manager of the gas, electric light and power plant of Westfield, Mass. Mr. Mitchell has been with the Boston & Maine railroad, has done consulting work in Boston, and has been identified in an engineering capacity with a number of power plants and electric railways of New England.

Claude E. Chappell has been appointed city manager of Jackson, Mich. Mr. Chappell was graduated from the civil engineering department of the University of Michigan in 1908. For the past 8 months he has been city manager of Big Rapids, Mich. Before that time he had been connected with the consulting engineering firms of Alvord & Burdick and Dabney H. Maury.

Capt. Robert R. Ralston, Corps of Engineers, U. S. Army, formerly on duty at the War Department as assistant to the chief of engineers, has been ordered to Cincinnati, Ohio, for duty in connection with river and harbor work in that vicinity. He will be relieved of his duties at the War Department by Capt. Alvin B. Barber, who has been engaged in river and harbor work on the Pacific coast.

T. E. Phipps, who has been connected with the engineering department of the Chicago, Milwaukee & St. Paul Railway for several years, has been selected by the Public Service Commission of the State of Washington, as chief engineer of that body to fill the vacancy caused by the withdrawal of Fred S. Burroughs. Mr. Phipps is a graduate of the University of Illinois and has at various times been connected with the Big Four Railroad, the Walsh Construction Company, of Davenport, Iowa, and the coast section of the Chicago, Milwaukee & St. Paul Railway.

Obituary Notes

George H. Webster, a Canadian engineer long identified with the Canadian Pacific Railroad, died Dec. 29 at Vancouver, B. C.

Joseph McCabe, railroad and tunnel builder, who as a member of the firm of McCabe & Bihler, built the New York, New Haven & Hartford Railroad tunnel under the East Side hill at Providence, R. I., and did other important tunnel work on this road, died on Jan. 3 at New Orleans, La.

Thomas Coltrin Keefer, one of the founders and twice president of the Canadian Society of Civil Engineers, died on Jan. 7 at Ottawa in his ninety-fourth year. Mr. Keefer began his engineering career on the Erie Canal. In 1850 he was engaged by the Canadian Government to make a survey of the rapids of the St. Lawrence River with a view to building either a canal or railway between St. Lawrence and upper St. John waters of Lake Temisconata. After this he was engaged in preliminary surveys for the Grand Trunk Railway between Montreal and Toronto, and prepared plans for the Victoria Bridge. Mr. Keefer designed the waterworks of Hamilton, Ont., of Montreal and of Ottawa. It is said that the change from narrow to standard gage on the railways of Canada was due largely to his efforts. Mr. Keefer was commissioner to the Paris Exhibition, and was at that time elected a member of the Legion of Honor. His engineering publications have made his name familiar throughout Canada. Among them are his "Philosophy of Railways," published in 1849, which greatly influenced the Government policy regarding the construction of railways, and numerous other essays, lectures and reports. In one of these he advocated the construction of the Canadian Pacific Railroad. His work and writings stamp him as a man of remarkable foresight in public affairs.

Civil Service Examinations

United States.—The following examinations will be held:

STRUCTURAL STEEL DRAFTSMAN, $3.52 to $5.52 per day, throughout the country, Feb. 3 and 4. Four years' experience, a year and a half of which must be in drafting, required. Technical course counts as two years. Applicants must be twenty-one years of age.

ORDNANCE DRAFTSMAN, $3.28 to $5.08 per day, throughout the country, Feb. 4 and 5. At least a two-year engineering course and three years of practical experience are required. Applicants must be eighteen years of age.

TOPOGRAPHIC AID, $40 to $75 per month, throughout the country, Feb. 3. Applicants must be between twenty and forty years of age.

JUNIOR TOPOGRAPHER, $720 to $1200 per year, throughout the country, Feb. 4 and 5. Applicants must be between twenty and thirty years of age.

CIVIL ENGINEER STUDENT, $720 per year, throughout the country, Feb. 3. Applicants must be graduates of a technical school or college, but may receive their degree after the examination (but before appointment) in June, 1915. These positions offer an opportunity for practical construction experience in connection with Government road work. Applicants must be twenty years of age.

COPYIST ORDNANCE DRAFTSMAN, $2.80 per day to $3.04 per day throughout the country, Feb. 3. Applicants must be eighteen years old and have had a high-school education and one year's experience in drafting.

Full information and application blanks can be had from the nearest local secretary of the United States Civil Service Board, or from the United States Civil Service Commission, Washington, D. C.

Illinois State.—An examination will be held Feb. 6 for the position of assistant utilities engineer, $90 to $125 a month. Open only to residents of Illinois. Applications must be on file Jan. 30. For full information address the Illinois State Civil Service Commission at Springfield.

Examinations Previously Announced

Date		See Engineering Record
Jan. 20, 1915	Junior railway civil and structural engineers, United States	Dec. 19
Jan. 23, 1915	Specification writer, Grade II; assistant chemist; junior assistant, engineering departments; junior draftsman; map draftsman; chief surveyor; engineering draftsman; New York State	Dec. 26
Feb. 2, 1915	Sanitary engineer, United States	Jan. 2

Coming Meetings of National Engineering Societies

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West 57th St., New York. Meets first and third Wednesday, except in July and August. Annual meeting in New York, Jan. 20 and 21.

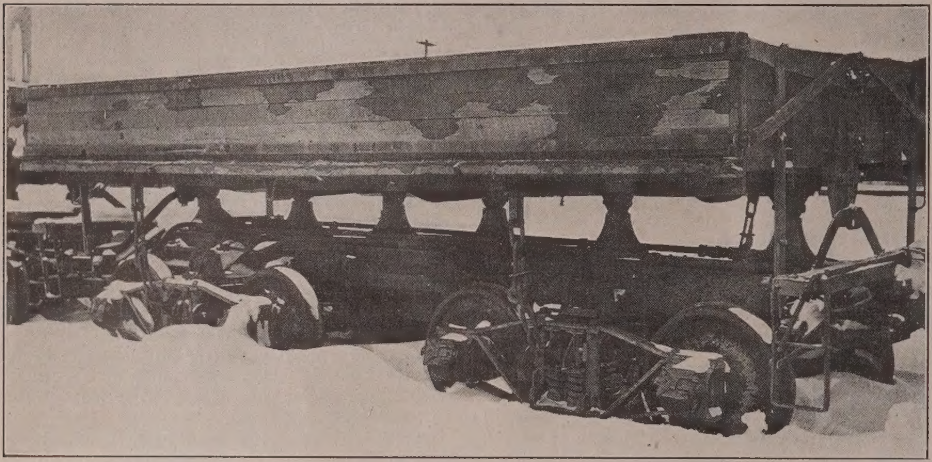
CANADIAN SOCIETY OF CIVIL ENGINEERS. Secretary, Clement H. McLeod. Meets Thursdays, in Montreal, except during the months of May to September, inclusive.

INTERNATIONAL ENGINEERING CONGRESS. Secretary-Treasurer, W. A. Cattell, Foxcroft Building, San Francisco, Cal. Meeting Sept. 20-25, 1915, San Francisco, Cal.

U. S. Government Exhibit at Exposition to Cost $ 500,000

Preparations are now nearing completion for the U. S. Government exhibit at the Panama-Pacific Exposition. It is to occupy a total of 173,000 sq. ft. of space in the several palaces and is said to be the most elaborate exhibit ever made by one Nation. It will cost $500,000.

In the Palace of Mines and Metallurgy the U. S. Bureau of Mines is constructing a series of model mines beneath the floor. There will also be in this building an exhibit of the post-office department designed to serve as a working model, where all of the Exposition mail will be received and distributed. Another working model will represent one of the Government mints. In the Palace of Machinery will be a display of the manufacture of arms and armament, showing the technical and mechanical side of the army and navy operations. Here also will be the exhibit of the lighthouse department and a miniature model of a naval drydock.



THE SIDE DOOR OF THIS CAR HAS STOOD A YEAR'S WEAR HAULING BROKEN STONE

The largest display will be in the Liberal Arts Building, where the Government has taken more than 65,000 sq. ft. of space. The American Red Cross Society will demonstrate the work it is doing on the battlefields of Europe and elsewhere. The educational exhibit of the army and navy departments will show how soldiers and sailors are trained. The Federal Health Department, the Department of Commerce and Labor, the Interior Department, including the land department and Bureau of Indian Affairs, and a number of other departments will also be represented.

Durable Side Doors for Dump Cars

A side door for dump cars, made of solid timber and reinforced top and bottom with steel rails, which are secured to the four trunnions at the end of the car, is illustrated in the accompanying cut. It is said that the car shown has been in use for over a year in the transportation of heavy rock by a firm of Eastern contractors. These doors are made by the Improved Car Side Company, 50 Church Street, New York City.

Coal Production Will Increase

A hopeful tone prevailed at the beginning of the year in coal mining circles, despite the fact that the 1914 production of bituminous coal fell off over 10 per cent from the record output of 1913. According to the report of the statistician of the U. S. Geological Survey, the consumption of anthracite coal decreased only a little over 1 per cent in the same time. The chief falling off was noticed in the Pittsburgh and Alabama coking districts, where decreases as high as 30 per cent from the figures of 1913 were recorded. The West Virginia fields had to supply the market cut off by the strike in the Ohio coal district, and showed an actual increase in production. It is doubtful if the European war had, or will have, except indirectly, much influence on the coal situation. Our exports go mostly to Canada, and are neither large nor increasing in volume.

New Contractor's Motor

A new large slip ring induction motor has been brought out by the Westinghouse Company. This motor is for continuous service, and is designed especially for driving machines that require heavy torque at starting. It is intended as an improvement for electric hoists, pumps and compressors.

Business Notes

The Holt Manufacturing Company, of Stockton, Cal., announces that G. T. Du Bose has been appointed superintendent of their Stockton plant.

Joseph T. Ryerson & Son, of Chicago, have advertised a prize of $100 for the best name to cover a line of tool steels which they are selling.

Ruben Bowen has been elected president of the Canton Hughes Pump Company, of Wooster, Ohio. Mr. Bowen was formerly general manager of the Epping-Carpenter Pump Company of Pittsburgh.

The Chicago Bridge & Iron Works have closed their office at San Francisco, Cal., and have opened an office at Monticello, Fla. This office, which is in charge of E. G. Ladd, will cover work in the States of Florida, Georgia and Alabama.

The Kerr Turbine Company, of Wellsville, N. Y., has announced that its New York office is now in charge of a new district manager, Benjamin G. Fernald. Its office remains in the Singer Building, but has been removed to the Annex at 95 Liberty Street.

J. C. Kernchen, of Chicago, announces that the name of the company has been changed to the Arex Company. The new company will continue to manufacture and sell the Arex siphonage ventilator.

H. B. McMaster, commissioner for the Associated Metal Lath Manufacturers, who has been directing the co-operative work of the metal lath industry since 1910, has resigned to become manager of branches for The Berger Manufacturing Company, of Canton, Ohio. This concern produces sheets and sheet metal products.

Trade Publications

The following companies have recently issued trade publications:

A. Strich & Bro. Company, Chicago, Pamphlet describing an improved dump wagon for garbage disposal.

Waterbury Company, New York City. Pamphlet, 3 x 6 in., 24 pages. Describes a marline-wound wire rope known as "fiber-clad."

The Chicago Pneumatic Tool Company, Chicago. Bulletin 341C, 6 x 9 in., 22 pages. Description of compressors driven by fuel oil engines.

The Archbold Brady Company, Syracuse, N. Y. Pamphlet, 32 pages. Deals with steel transmission structures and catenary bridges. Illustrated.

The Minneapolis Steel & Machinery Company, Minneapolis. Catalog, 6 x 9 in., 105 pages, describing improved steel derricks and steam and electric hoists.

Pawling & Harnischfeger Company, Milwaukee, Wis. A booklet, 8 x 10 in., 52 pages, illustrated in color. Special features of "P. & H." machinery, chiefly cranes and hoists.

Weber Chimney Company, Chicago, Ill.—An illustrated 4-page mailing folder describing four Weber chimneys, built for the Havana Electric Railway, Light & Power Company, Cuba.

The Busch Sulzer Bros. Diesel Engine Company, St. Louis. Pamphlet, 7 x 10 in., 16 pages. Describes recent tests conducted on Diesel engines by A. C. Scott, consulting engineer of Dallas, Tex.

Roe Stephens Manufacturing Company, Detroit, Mich. Catalog F, 6 x 9 in., 44 pages, with engravings. Michigan compression and gate hydrants for high and low pressure, gates, valve boxes, etc., and sluice gates.

Turner Construction Company, 11 Broadway, New York City. Booklet bulletin 14, 9 x 12 in., 12 pages, illustrated. Describes in detail company's organization and illustrates some of the reinforced-concrete structures it has built.

The Goulds Manufacturing Company, Seneca Falls, N. Y. Bulletin 119, 7¾ x 10 in., 12 pages, illustrated. Describes the recently marketed Goulds centrifugal pumps, single stage, single suction, inclosed impeller type. Tables of speed and friction loss are given.

Allis-Chalmers Manufacturing Company, Milwaukee. Catalog, 8 x 10½ in., 64 pages, illustrated. This publication introduces the Allis-Chalmers "Hummer," a small portable rock-crusher for producing ground limestone for soil improvement. Extracts of reports on the use of this chemical are also given.

General Electric Company, Schenectady, N. Y. Bulletins 42010 and 42300, 8 x 10½ in. each, 14 and 12 pages, respectively, illustrated. Horizontal turbo-generator sets of small capacities largely used for supplying light in mills and machine shops and on trains. Steam engine-driven generator sets, of small capacities for both power and lighting purposes in isolated districts.

Lackawanna Steel Company, Lackawanna, N. Y. An ornate booklet of 24 pages describing and illustrating the Lackawanna deseaming process for rail sections. This process was described and discussed by Capt. Robert W. Hunt at the recent annual meeting of the American Society of Mechanical Engineers, and his paper was abstracted in the Engineering Record of Dec. 12, 1914, page 636.

The Parsons Company, Newton, Iowa. Catalog, 9 x 12 in., 32 pages, illustrated. Design and construction of Parsons trench excavators, introducing two improved models, E and F. Describes special excavating work done with Parsons trenchers. Supplementary data of costs and specifications of these machines are included. The arrangement of the catalog is artistic and the information is well presented.

Creosoted Douglas Fir Paving Blocks is the title of a treatise recently published by the West Coast Lumber Manufacturers' Association and the Association of Creosoting Companies of the Pacific Coast. The booklet gives a brief outline of the history of wood block and its advantages in large cities, including London and Paris. There is a general specification for the construction of subgrade and foundations of highways and for selecting, creosoting and handling wood blocks.